

YOGA SURYANAMASKAR TRAINING INCREASING FLEXIBILIT

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YOGA SURYANAMASKAR TRAINING INCREASING FLEXIBILITY AND STRENGTH OF BACK MUSCLE, AS WELL AS LUNG VITAL CAPACITY OF UNIVERSITAS HINDU INDONESIA STUDENTS

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Abstract. Yoga has been believed to be able to improve physical health and fitness. This research aims to study suryanamaskar yoga training three times a week for six weeks in improving flexibility, back muscle strength, and vital lung capacity in Indonesian Hindu University students. This study uses a One-Shot Case Study design. The female subjects were 15 people, aged between 18-25 years. Subjects were given treatment in the form of suryanamaskar yoga training with a duration of three times a week for six weeks. Flexibility, leg muscle strength, and vital lung capacity were measured before and after treatment. The results showed that there was an increase in the mean muscle strength and back strength, as well as significantly lung vital capacity ($p < 0.05$). The percentage increase in mean flexibility, back muscle strength, and vital lung capacity respectively is 18.99%; 28.18%; and 9.59%. Conclusion, suryanamaskar yoga training three times a week for six weeks can improve flexibility and strength of back muscle, as well as lung vital capacity in Indonesian Hindu University students.

Keywords: Suryanamaskar Yoga, Flexibility, Strength of back muscles, Vital lung capacity.

Preliminary

Yoga originating from India is an exercise/physical, mental and spiritual activity that is 5,000 years old, aiming to transform the body and mind, control and achievement; harmony between humans and the universe with a holistic approach to health and well-being (Basavaraddi, 2013).

Sports that are carried out regularly and continuously will produce physiological changes, which can increase the area of movement of joints so that it can increase flexibility; increase muscle strength and endurance; improve nerve function in the form of faster reaction times and the ability to coordinate better muscle function; blood circulation becomes faster and smoother; improve heart function, work the heart becomes more efficient and there is a decrease in heart rate; and can also improve lung function due to the breathing muscles

becoming strong so that the diffusion process gets better and also increases oxygen consumption which will reach the maximum state which is known as maximum oxygen consumption (VO₂-Max) (Giriwijoyo & Sidik, 2012; Kuntaraf & Kuntaraf, 2009).

Increased functional capabilities as a result of physical activity can be in the form of a variety of conditions involving 10 bio-motoric components (basic abilities of physical motion or physical activity of the human body), namely: durability, strength, explosive power, speed, flexibility, agility, accuracy, reaction time, balance, and coordination (Bompa and Haff, 2009). From the point of view of Sport Science, the components are physical fitness components (Giriwijoyo and Sidik, 2012). These components are needed by every human being to be able to perform physical activities efficiently and productively both while working and exercising (Nala, 2011).

One of the complete and easy-to-implement yoga movements is suryanamaskar. Suryanamaskar yoga is very useful for the body and is a very popular yoga training model by combining various benefits of asanas, pranayama and mudras simultaneously. Suryanamaskar Yoga is composed of 12 movement postures that can be done in the morning or evening facing the sun. Suryanamaskar's yoga movement will energize the neuro glandular and neuro muscular systems of the body, and regular training guarantees a balance of blood oxygen intake and harmonizes the entire body system, thereby refreshing or nourishing the entire psychosomatic system of the body (Basavaraddi, 2013).

The series of suryanamaskar movements that are carried out regularly and continuously are very useful to strengthen the main organs and the whole muscle, increase the flexibility of the spine and joints, improve breathing and heart rate; increase concentration and calm the mind against the problems faced (stress), and facilitate digestion (Rianti, 2009; Sindhu, 2013).

The results of the research on suryanamaskar yoga training conducted by Shankar and Pancholi (2011), showed increasing flexibility and increasing endurance of the upper body muscles, as well as reducing blood pressure. Furthermore, Mertayasa (2013) also reported the results of a four-week suryanamaskar yoga training study on 30 students, found an increase in vital lung capacity and flexibility.

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The present study tested efficacy of regular practice of suryanamaskar in improving the cardio-respiratory fitness. The present study was conducted on 78 subjects, (48 males and 30 females). It was observed that 6 months of suryanamaskar practice decreases resting pulse rate and blood pressure. At the same time it increases cardio-respiratory efficiency and respiratory capacity as evaluated by bicycle ergometer and various lung functions tests, in both male and female subjects (Bhutkar et al., 2008).

Considering the enormous benefits of yoga on the physical individual, it is important to conduct a study of "Suryanamaskar Yoga Training Increasing the Flexibility and Strength of Back Muscles, and Lung Vital Capacity in Students of Indonesian Hindu University" to obtain scientific concepts about the benefits of suryanamaskar yoga training on chronic physiological responses body and can be used as a guide by yoga practitioners in an effort to improve physical fitness. The training provided lasts for six weeks with a frequency of three times a week, taking in consideration that according to Nala (2011) physical training is given within a period of 6-8 weeks and with a frequency of three times per week, the body

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has been adapted to the training with constant results. The purpose of this study to determine the effects of suryanamaskar yoga training three times a week for six weeks can improve the flexibility and strength of back muscles and vital lung capacity in students of the Indonesian Hindu University.

Method

This research is a Quasi-experimental study with a One-Shot Case Study design (Nazir, 1999). The research subjects were 15 students (age of 18-25 years) of Yoga Student Activity Unit Indonesian Hindu University, before the treatment was carried out observations of limb muscle flexibility and strength, as well as vital lung capacity (pre-test). Then each subject was given the same treatment, namely suryanamaskar yoga training with a duration of three times a week for six weeks. Back muscle size and strength, as well as lung vital capacity, were measured after six weeks of training (post-test).

The research subjects conducted suryanamaskar yoga training for one hour, where there were as many as 12 series of movements ranging from the first movement to 12 movements, almost no interruption. However, each time a series of movements is completed, a break of 10 seconds is taken to regulate the breath. After completing a series of movements, continue with the next series of movements 12 times.

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The measuring instrument used in this study for the flexibility test is sit and reachable in units of centimeters (cm) and back muscle strength tests using a back-lag-chest dynamometer with units of kilograms (Kg). While the vital pulmonary capacities-test uses a digital spirometer (Contec SP 10 W brand with units of mL).

The data obtained were analyzed statistically using parametric and non-parametric tests. A comparative test to compare the average data difference between before and after training for back muscle strength was used paired t-test because all data compared were normally distributed, while back muscle flexibility and vital lung capacity between before and after training were tested by the Wilcoxon test, because one of the data is not normally distributed. The significance limit used is $\alpha = 0.05$.

Results And Discussion

To find out the distribution of back muscle flexibility and strength data, as well as vital lung capacity pre and post training test, the Saphiro Wilk-test was used. Whereas to find out the difference in data pre and posttest the back muscle strength training was tested by parametric test with paired t-test, then for back muscle flexibility and vital lung capacity between pre and post training were tested with non-parametric Wilcoxon test. The test results are listed in Table 1.

Table 1. Differential Test Results for Average Back Muscle Detection, Back Muscle Strength, and Lung Vital Capacity between Pre and Post Training

Variable	Normality p Value (Saphiro Wilk test)		Mean ± SD		Mean Difference	p Value
	Pre Test	Post Test	Pre Test	Post Test		
Back Muscles Flexibility (cm)	0,867	0,010	14,80 ± 4,77	18,27 ± 4,75	3,47	0,001
Back Muscle Strength (Kg)	0,615	0,116	45,73 ± 15,75	63,67 ± 14,46	17,94	0,000
Lung Vital Capacity (mL)	0,139	0,002	2073,33 ± 246,31	2293,33 ± 252,04	220,00	0,003

Table 1 shows the distribution of data on the initial flexibility test and strength of back muscle strength, as well as vital lung capacity, all of which were normally distributed ($p > 0.05$). Furthermore, the distribution of the final test data for back muscle strength is normally distributed, while the distribution of the final test data for spastic muscle flexibility and vital lung capacity is not normally distributed ($p < 0.05$). The difference in the initial test data with the final test of flexibility and strength of the back muscles and vital lung capacity, the difference in data on all the different variables was significantly with a value of $p < 0.05$. This means that there is an increase in the effect of suryanamaskar yoga training on flexibility and strength of the back muscles, as well as significantly vital lung capacity with a value of $p < 0.05$.

Flexibility is the body's ability to extend itself to the fullest extent supported by the extent of movement in the joints. This ability is closely related to the ability to move large muscle groups and their working capacity and is also related to the ability to stretch muscles and tissues around the joints (Nala, 2011). The results of the research showed that there was a significant increase in the elasticity of the back muscles of 3.74 cm (18.99%). This means that there is an effect of suryanamaskar yoga training on the flexibility of the back muscles. These results are in accordance with the research conducted by Mertayasa (2013) on male students of SMAN 2 Bajra Buleleng, said that there was an increase in flexibility of the back muscles after suryanamaskar yoga practice. Research that is in line with the results of this study is Suharjana's (2013) study, of 20 boys and 20 girls in static stretching and dynamic stretching. Significant differences occur, namely on static stretching there is an increase in flexibility of the back muscles that are higher compared to dynamic stretching. This shows that static stretching exercises such as those performed on suryanamaskar yoga practice are better than dynamic stretches in increasing the flexibility of the back muscles. This also means that static stretching carried out regularly can increase the flexibility of the back muscles.

Yoga practice is a static stretch that involves a lot of flexion movements from the torso, which is the most important movement in everyday life. This means that torso movements

are very often and widely carried out in everyday life, both when working and exercising. Thus these muscles must be trained to be more flexible and stronger so as to reduce the possibility of injury (Answar, 1988). Furthermore Giriwijoyo (2007) states that one of the physiological changes from the effects of physical training is that the area of joints can be maintained or maintained and can even be increased, thus preventing stiffness of the joints and even increasing the flexibility which increases the possibility of movement.

The suryanamaskar yoga training that is carried out regularly causes the joints to be adapted to the given load which will stretch. This stretch results in an increase in the length of the sarcomere which is the basic unit of the length of the muscle fibers, especially in the meeting area between the muscle and the tendon (myotendinous junction). Stretching the unit results in increased muscle length, and consequently an increase in elasticity of joint ligaments and capsules, namely the area that connects the bones so that the joint space is wider. An increase in elasticity of the ligaments together with increased flexibility (McArdle et al., 2010). Increasing joint motion space due to regular suryanamaskar yoga training will lead to increased flexibility in the back muscles.

Strength is defined as the maximum work produced by a muscle or group of muscles or it can also be defined as the ability of the neuromuscular system to produce an external resistance force (Bompa, and Haff, 2009). The results showed that after suryanamaskar yoga training there was a significant increase in the strength of back muscles by 17.94 kg (28.18%) with a value of $p < 0.05$. This means that there is an effect of giving suryanamaskar yoga training to significantly increase back muscle strength.

This increase can be caused by the presence of detainees during suryanamaskar yoga movements during training in the form of internal detention from within the body itself, namely contraction of the back muscle group is held by contraction of other muscle groups and also the external prisoners from outside the body in the form of body weight themselves (trainees) when bending, looking up, and several other movements, and other external prisoners in the form of body movements, namely the back muscle group and also the arms that fight or push the flat plane. According to Nala (2011) muscle strength can be increased by giving prisoners internal and external to the muscles concerned. Internal detention in the form of detention from within the body itself, where contraction of a group of muscles is inhibited or opposed by contraction of other muscle groups, for example the right arm flexes the left arm. While external detainees, can from holding their own body weight when doing sit-down movements (sit ups), reject lift (push ups) and others.

Increasing the strength of the back muscles in this study is closely related also to the increased flexibility of the back muscles. Nala (2011) says that before exercising muscle strength, the muscles and ligaments that support the movement are strong in maintaining the balance and coordination of the desired movement. To get balance and coordination the flexibility of the muscles must be well trained first. Thus suryanamaskar yoga training is carried out, besides increasing muscle flexibility also increases muscle strength simultaneously.

Increasing the strength of the back muscles after training suryanamaskar yoga can also be caused by the enlargement of the back muscle group. The individual burden that occurs during suryanamaskar yoga training is the weight of the body of the trainee. The body burden will cause a very strong contraction when carrying out suryanamaskar movements that support the body so that the back muscles become strong. According to Bompa and Haff (2009) with

the presence of strong contractions there will be increased myofibrils which cause muscle fibers to become hypertrophy (increase in muscle fiber size), and this is one of the factors that affect muscle strength. Further said by Bompa and Haff (2009) an increase in muscle cross-sectional area is thought to contribute to increased muscle hypertrophy and is seen as a response to endurance training. Increasing the cross-sectional area of this muscle, will increase the number of contractile motor units and thus increase in the production of forces that play a role in increasing muscle strength.

Muscle hypertrophy resulting from physical exercise is also caused by an increase in contractile elements in muscle fibers (muscle active strength), thickening of the sarcolemma, and increased connective tissue between muscle fibers which causes increased muscle passive strength. Thus hypertrophy of muscle fibers leads to increased muscle active strength and increased passive muscle strength, i.e. the muscles become stronger and resistant to strain and the maintenance of muscle homeostasis increases so that endurance increases (Giriwijoyo & Sidik, 2012).

The biochemical changes from the effects of physical exercise include increasing the number of PCs (phosphocreatine), muscle glycogen, myoglobin, and enzymes that are important for aerobic processes (oxidative enzymes) contained in mitochondria. These oxidative enzymes can be doubled in aerobic-trained muscles. This will cause muscle strength to increase (Giriwijoyo & Sidik, 2012). Based on this description, the effects of suryanamaskar yoga training result in muscle hypertrophy which can increase the strength of the back muscles.

Lung vital capacity is the same as inspiratory reserve volume plus tidal volume (air coming out during normal breathing) and expiratory reserve volume, this is the maximum amount of air that can be removed from the lungs, after first filling the lungs to the maximum and then removing as much as the amount (Guyton & Hall, 2016). The results of this study indicate that after training yoga suryanamaskar there was a significant increase in lung vital capacity of 220 ml (9.59%) significantly with a value of $p < 0.05$. This means that there is an effect of giving suryanamaskar yoga training to significantly increase lung vital capacity.

Increased vital lung capacity is obtained after training, because suryanamaskar yoga training contains exercises in regulating breath, both breathing, holding, and exhaling. Breathing exercises in yoga training will adapt to contractions of the breathing muscles, this will certainly help develop the strength of the respiratory muscles, which will also give an effect on the process of diffusion (gas exchange) that is an increase in the maximum amount of air that can be inhaled and the maximum amount of air that can be exhaled or it can be said that lung vital capacity will also increase.

The process of inspiration and expiration is stated by Guyton and Hall (2012) depending on the strength of the respiratory muscles. Furthermore stated by Guyton & Hall (2016), the lung is one organ that does not have its own muscles, so one of the factors that affect the vital capacity of the lung is the strength of the respiratory muscles in the development and sucking of the chest cavity. Furthermore Fox (1983) also states the effect of physical exercise on the respiratory system is the change in lung volume (inspiration and expiratory reserve volume), this is due to an increase in the strength of the skeletal muscle that is responsible for the circulatory process.

In addition, the increase in lung vital capacity after training can also be caused by an increase

in lung function, the effect of breathing exercises on the training, which can affect the maximum air increase that can be inhaled or exhaled. Increased lung vital capacity after yoga suryanamaskar training also occurs in male students of SMA N 2 Banjar Buleleng, reported by Mertayasa (2013), said that the adaptation of breathing muscles after being given training in yoga suryanamaskar regularly is due to contraction of the diaphragm muscles and m.intercostalis eksternus that lifts the ribs at the time of inspiration, the chest cavity will enlarge and allow the lungs to expand maximally, thus optimizing the filling of air to the lungs, and the opposite occurs when contractions occur from m.rectus abdominis and m.intercostalis internus during expiration. Respiratory arrangements performed during suryanamaskar yoga allow the breathing muscles to contract and relax normally, so that the lung ventilation mechanism can function properly. Likewise the results of a study conducted by Akhtar et al. (2013) on yoga training on vital lung capacity, there was a significant increase in lung vital capacity after suryanamaskar yoga training.

With the strengthening of the breathing muscles, the ability of the lungs to breathe and exhale maximum air can be done well. This is reflected in the significant increase in lung capacity after the training of suryanamaskar yoga was regularly and programmed

Conclusion

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Based on the results of the study it can be concluded that suryanamaskar yoga training three times a week for six weeks can increase flexibility and strength of the back muscles, as well as vital lung capacity in Indonesian Hindu University students.

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