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Original article

EFFECT OF KAATSU TRAINING ON SERUM PROTEIN ELECTROPHORESIS AND PERFORMANCE LEVEL OF 100M HURDLES FOR FEMALE COLLEGE STUDENTS

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Abstract*

Aim. KAATSU training is performed under conditions of restricted blood flow. It can induce more of beneficial effects such as increased muscle power, and it has been adopted by a number of facilities in recent times. The purpose of the present investigation was to describe the effects eight weeks of KAATSU training on serum protein electrophoresis and performance level of 100m hurdles for female college students.

Methods: Twenty female students from faculty of physical education for girls (age 19.8 +/- 1.9 years) participated in this study. The sample was distributed equally into two groups, the experimental group contains (10 female students) and the control group contains (10 female students), the experimental group participated in the KAATSU training program for eight weeks and the control group participated in the traditional program that used in the faculty. All participants completed the tests before and after the 8-week programs.

Results: The data revealed that

• Significant Difference between the experimental group and control group in Total protein and Creatinine for posttest to the experimental group.

• No Significant Difference in Blood urea nitrogen, Urea, Uric acid and 100m hurdle time for female college students.

Conclusions: The findings indicated that the KAATSU training for eight weeks could an improvement in serum protein, Creatinine and performance level of 100m hurdles. These results have to be taken into account by teachers in order to better understand and implicated of these concepts in educational lessons.

Keywords: KAATSU Training, Resistance Exercises, Protein Electrophoresis, Athletics

Introduction

It has been a major concern that scientists have been interested in since ancient times is the acquisition of knowledge. Therefore, the knowledge of this effort has gone through extensive steps to explore everything that is new and from the beginning of creation until the present time until the clock and even compared that development including in our 21st century world. Scientific inventions and inventions have multiplied exponentially from earlier times.

Because of this rapid development in all occupations was inevitably on the sports sciences to keep pace with the progress. In addition, where the nature of sports practice and the achievement of the record came researchers to various knowledge to try to use them and use different applications on sports.

For the vast majority of people it is still a completely unknown "Kaatsu" training. Although in the Western world, it is often referred to as "occlusive training" or "blood flow restriction training".

Training with blood flow restriction or occlusive training authorized for the first time in Japan in 1983, within the framework of a state plan for theAutonomy of the Japanese elders. Invented by Yoshiaki Sato, who called him Kaatsu training, being one day in a Buddhist temple, realized that after being long on his knees, he felt a sensation similar to the one he had after training; This gave him the idea of applying pressure on his muscles with a kind of tourniquet at the time of training. After many

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years of experiments in itself, Sato concluded that this training method was beneficial in increasing strength and muscle mass even applying low loads on your training. However, Sato suffered an accident by abuse of his own. In addition, had to be hospitalized with a diagnosis of pulmonary embolism and the time he was highly reproached by his doctor arguing that what he was doing it was crazy and something insane. This did not discourage Sato, but motivated to look for the adequate dose of vascular occlusion, a dose that was safe and at the same time beneficial. (Loenneke, et al, 2012)

Itis based on the fact that during exercise, the circulatorysystem adapts its response to the needs of the body by supplying oxygen, which is used asFuel and removing waste from the metabolism to avoid an increase in muscle acidosis. (Manini, Clark, 2009).

The main characteristic of this type of Training is to apply a pressure that reaches or exceeds systolic blood pressure (Manini and Clark, 2009). For this purpose, it has been recommended to use occlusion sleeves in that the pressure would be regulated according to the width and the size of the sleeve, between values of 100 to 200 mmHg (Loenneke, et al, 2012; McEwen, et al., 2002; Younger, et al. 2004).

In any in actual practice, other materials such as elastic bands,Inflatable or surgical turnstiles as substitutes for pressure hoses (Martin-Hernández, et al. 2011).

With restriction of blood flow in the proximal part of the limb that is, desired training during low-intensity training reduces arterial venous rinsing, drastically changing the metabolic requirement of the exercise. Miscellaneous work shows Kaatsu's ability to increase strength and muscle mass of subjects of disparate ages and physical condition. Thus, therapy not only has been shown to be useful for improving strength and muscle mass of older people,As it was the object of its conception, but also to prevent the atrophy of personsRenal patients or patients in the rehabilitation period after an interventionsurgery. (Kraemer, et al., 1990).

Kaatsu training produces muscle growth through two main mechanisms:

1. Altered order of recruitment of muscle fibers and increased metabolic stress.
2. Alteration in the order of recruitment of muscle fibers:

In the muscles there are two major types of muscle fibers, those of fast contraction and those of slow contraction (you can find a much more detailed description of them in our article "Muscular fibers and training"). Fast twitch fibers are the largest muscle fibers and have the greatest potential for growth. These fibers are most recently recruited during muscle contractions and are mostly anaerobic (do not use oxygen) while the slower contraction fibers are recruited first during contractions and are aerobic (using oxygen).

Kaatsu training by restricting blood flow to the muscles, pre-fatigue the slow-twitch fibers and forces the fast-twitch fibers to activate even at low intensities so that metabolically the muscle is working in a similar fashion to which would do it if we were using heavy loads but with the use of loads much lighter. (Madarame, et al., 2008)

At the metabolic level, it has been shown that Kaatsu can increase growth hormone levels up to 290% compared to traditional training, however, it is not yet clear how this relates to muscle hypertrophy.

Other data show that in addition to this, it also increases muscle protein synthesis, mTOR signaling (an enzyme responsible for muscle protein synthesis), increased activation of satellite cells (another process that influences hypertrophy), and decreases levels of Myostatin (a type of protein that limits muscle growth).

Is it Kaatsu's safety? Usually this question first comes to mind when hearing about this technique, however, research has shown that Kaatsu is a safe training technique. (Takarada, et al., 2000)

A large study has described the adverse effects observed after performing vascular occlusion training. The study was conducted over more than 12,000 sessions, and hematoma (13.1%), limb numbness (1.3%) and mild dizziness (0.3%) were described as side effects that are more common.

Other serious side effects, such as venous thrombosis, have manifested very rarely (0.06%); with an incidence rate even lower than the general average.

This study includes sessions conducted with people of all age ranges and different physical conditions, such as cerebrovascular diseases, orthopedic deficiencies, obesity, heart disease, neuromuscular diseases, diabetes, hypertension and respiratory diseases.The study concludes that, in short, moderate and light ischemia has been shown to be a completely safe element in healthy individuals, but for safety and prevention reasons, its application to people with cardiovascular risk factors is not recommended.

To ensure the effectiveness of any type of training method, this must be done by ensuring the maximum possible physiological benefit.

Proteins are important building units in all cells and tissues; they are important for the growth and health of the body. Therefore, this test measures the levels of different types of proteins in the plasma portion of the blood.

There are two types of proteins found in the blood, albumin and globulin. The albumin is the holder of many small molecules, but its main function is to prevent fluid leakage outside the blood vessels, through the Osmotic Pressure.

The ratio of albumin to A/G Ratio is calculated by obtaining the values of both total protein and direct protein, and this is indicated by the relative amounts of albumin and globulin.

Hussein and Nadir (2003) point out that protein play a major role in building living matter, as well as in carrying out processes of biological activity. When life is found, it is linked to the existence of a protein body and wherever there is a protein body, we encounter without exception the phenomena of life.

Hussein (1999) states that proteins include essential security acids that the body cannot manufacture them and is estimated to have 10 amino acids, and the 12 essential amino acids that the body can manufacture. Proteins in the gastrointestinal tract under the influence of intestinal yeast, pancreas and small intestine decompose to amino acids absorbed from the small intestine of blood and transported to the entire body.

Protein metabolism is also the result of hydrolysis, carbon dioxide, ammonia and urea. Hussein (1999) adds that protein metabolism and enzymes can infer liver, kidney and heart functions.

The purpose of the present investigation was to describe the effects eight weeks of KAATSU training on serum protein electrophoresis and performance level of 100m hurdles for female college students.

Methods

Twenty female students from faculty of physical education for girls (age 17.8 +/- 1.9 years) participated in this study. The sample distributed equally into two groups, the experimental group contains (10 female students) and the control group contains (10 female students), the experimental group participated in the KAATSU training program for eight weeks and the control group participated in the traditional program that used in the faculty. All participants completed the tests before and after the 8-week programs.

Kaatsu training protocols:

- Duration of the program:
- Duration of the program (8) weeks.

The majority of scientific studies have applied with positive results on muscular strength and hypertrophy, the following parameters can be found:

- Training frequency: 1 session per day of two to three times per week.
- Pressure or level of occlusion: 100-240 mmHg.

Note: Other studies recommend between 50 and 100 mm Hg. Although it is also frequent to find works that express the occlusion pressure in relation to the systolic blood pressure (SBP) of the individual; For example, 1.3 / PAS.

In addition to pressure, other variables influence the level of occlusion.such as the width of the band (greater width, greater occlusion for a same level of pressure).The perimeter of the limb or the Body composition of each individual.

- -Intensity (1% RM): 20-50%.
- -Repeats per series: 15 to 30 or more.
- Volume: 3 to 5 series to failure (60-70 repetitions per session).
- Density: 30 to 60 s. (Rest between sets)
- Execution speed: 2: 2 (2 seconds concentric phase and 2 eccentric phase)
- Total session time: 10 to 15 m.

All series are performed until muscle failure, and the tourniquet must be removed once all the series of the exercise is completed (it is maintained during the breaks) and should be avoided for more than 10-15 minutes.

Note: Exercise should be stopped immediately if you experience shortness of breath, dizziness or other discomfort, and perform the next session with a lower level of demand. It is normal to experience a strong burning in the last series.

When determining the adequate pressure of the tourniquet and since it is unlikely that the gymnasium will be used with a pressure gauge, a very useful form is as follows: the tourniquet is applied firmly but not too tightly, and we wait a minute ; At the end of this time you should feel your limb somewhat numb, but without experiencing any pain.

Biochemistry variables:

Blood urea nitrogen (BUN)

It is a medical diagnostic test used to diagnose the condition of the kidney. The normal range is 1.8 - 7.1 mmol /l.

The reasons for increasing urea nitrogen are eating foods with high nitrogen content,

Total protein

The total protein test is a component of the Comprehensive Metabolic Panel (CMP), which is required as part of periodic health checks. The test may also be required to give us a general idea of the patient's nutritional status, as in the case of underweight.

The test may also be requested with a range of other tests if the symptoms appear on the patient is motivated by suspected liver or kidney disease, or to check the cause of abnormal accumulation of fluids within the tissues.

Creatinine

Creatinine is a chemical waste product of Creatine. Creatine is a chemical produced by the body and is used to supply muscles with energy.

This test done to find out how the kidneys work well. Creatinine is removed from the body completely by kidney. If renal function is not normal, my skin will increase creatinine level in the blood. This is because the urine takes out creatinine.

The natural results of the creatinine blood test vary according to the size and muscle mass of the person.

Urea

It is the primary and final product of the metabolism of proteins in mammals. The urine is formed in the liver and then passes through the blood to the kidneys where it is released with urine and enters into the formation of toxic ammonia (NH_3), which consists of the destruction of amino acids. However, the ease of measurement made it common tests and the insensitivity of this test in that should lose more than 50% of the function of glomerular kidneys to be affected by the level of urine in the blood; moreover, there are many reasons non-renal origin can cause the rise of urine in Blood. As that, the level of urine in the blood is affected by proteins in food and the amount of glomerular glomerulonephritis in the kidneys.

The level of urine in the blood ranges between 20 - 40 mg / 100 ml blood (3.5 - 7 mmol / l)

Uric acid

It is the final product for the metabolism of Purine in humans, and enters purine in the synthesis of nuclear acids and includes Adenine and Guanine. The level of uric acid in the blood changes from hour to hour and from day to day. Many factors affect uric acid, including long fasting and food quality. The level of uric acid in the blood ranges from three to seven mg per 100 ml of blood in males (0.18 - 0.53) ml.

In females, the level of uric acid is between 2-6 mg ml (0.15-0.45 mmol / mL). The kidneys release the uric acid. About 80% of the uric acid in the body comes out with the urine, and the remaining part comes out with the bile.

Statistical analyses

All statistical analyses calculated by the SPSS 21 statistical package. Differences between the two groups reported as mean difference ±95percentage confidence. The relative reliability and absolute reliability analyzed through paired samples t-tests ($p \leq 0.05$).

Results

Table 1. Anthropometric characteristics and age of the groups (Mean ± SD)

Group	N	Age [years]	Weight [kg]	Height [cm]
Experimental	10	19.17 ± 0.5	67 ± 4.02	177 ± 5.68
Control	10	21.09 ± 0.6	69 ± 4.12	175 ± 5.92

Table 1 shows the age and anthropometric characteristics of the sample. Nosignificant differences observed in the anthropometric characteristics and age for the sample in the different groups.

Table 2. Mean ± SD and "T" Test between the pre and posttests for experimental group in Blood urea nitrogen, Total protein, Urea, Creatinine, Uric acid and100m hurdle time.

Variables	Experimental group		Rate %	Sign.
	Before	After		
Blood urea nitrogen (mg/100ml)	10.55±1.42	11.79± 1.46		NS
Total protein(g/100ml)	6.88±1.14	7.99 ±1.12		S
Urea(mg/100ml)	22.65±0.45	23.25 ±1.05		NS
Creatinine(mg/100ml)	0.94±0.06	1.29 ±0.12		S
Uric acid(mg/100ml)	5.13±1.02	5.21 ±1.27		NS
100m hurdle time (S)	16.54±0.25	16.21±0.22		NS

Table 2 shows that:

- Significant Difference between the pre and posttests for experimental group in Total protein and Creatinine for posttest to the experimental group.
- Significant difference between the pre and posttests for experimental group in Blood urea nitrogen, Urea, Uric acid and 100m hurdle time.

Table 3. Mean ± SD and "T" Test between the pre and posttests for control group in Blood urea nitrogen, Total protein, Urea, Creatinine, Uric acid and 100m hurdle time

Variables	Control group		Rate %	Sign.
	Before	After		
Blood urea nitrogen (mg/100ml)	9.89±1.12	10.73± 1.75		NS
Total protein(g/100ml)	6.87±1.11	6.90 ±1.11		NS
Urea(mg/100ml)	21.75±0.79	22.18 ±0.86		NS
Creatinine(mg/100ml)	0.91±0.04	0.96 ±0.08		NS
Uric acid(mg/100ml)	5.19±0.29	5.42 ±1.64		NS
100m hurdle time (S)	16.78±0.34	16.69±0.32		NS

Table 3 shows that:

- No Significant Difference between the pre and posttests for control group in Blood urea nitrogen, Total protein, Urea, Creatinine, Uric acid and 100m hurdle time.

Table 4. Mean ± SD and "T" Test between the two Groups (experimental and control) in Blood urea nitrogen, Total protein, Urea, Creatinine, Uric acid and 100m hurdle time

Variables	Experimental group	Control group	Sign.
	After	After	
Blood urea nitrogen (mg/100ml)	11.79± 1.46	10.73± 1.75	NS
Total protein(g/100ml)	7.99 ±1.12	6.90 ±1.11	S
Urea(mg/100ml)	23.25 ±1.05	22.18 ±0.86	NS
Creatinine(mg/100ml)	1.29 ±0.12	0.96 ±0.08	S
Uric acid(mg/100ml)	5.21 ±1.27	5.42 ±1.64	NS
100m hurdle time (S)	16.21±0.22	16.69±0.32	NS

Table 4 shows that:

- Significant Difference between the experimental group and control group in Total protein and Creatinine for posttest to the experimental group.
- No Significant Difference in Blood urea nitrogen, Urea, Uric acid and 100m hurdle time.

Discussion

The data revealed that Kaatsu training affected on these variables.

These results constant with many of studies which indicated that Occlusion has been shown to cause increased GH levels (Abe, et al., 2006; Fujita, et al., 2007; Madarame, et al., 2008; Pierce, et al., 2006; Reeves, et al., 2006; Takano, et al., 2005).

However, (Takarada, et al., 2000) showed the largest and fastest increase when investigating the hormonal and inflammatory responses to the exercise of low intensity overload with vascular occlusion in male athletes. The subjects performed the exercise of bilateral knee extensions with vascular occlusion. These investigators observed an increase in blood lactate that was twice as high as that observed in the control group, which was probably caused by local hypoxia and suppression of lactate clearance within muscles subject to vascular occlusion. An increase in norepinephrine (NE) levels was also observed in the exercise group with vascular occlusion, and the temporal course of changes in NE and GH concentrations appeared to be similar to that observed for lactate. The GH concentration was approximately 290 times higher than the pre-exercise level (Takarada, et al., 2000). This magnitude of increase in GH concentration was greater, by a factor of approximately 1.7, than that previously observed for training with high intensity overload with brief periods of recovery, indicating that exercise with occlusion can provoke a strong endocrine response, even with extremely low exercise intensities (Kraemer, et al., 1991). No changes were observed in Creatine kinase or lipid peroxidation levels between the groups, suggesting no serious muscle damage. These investigators found that the concentration of interleukin 6 (IL-6) increased gradually but was only slightly higher than in the control group (Takarada, et al., 2000). For this reason, the researchers suggested that a slight increase in IL-6 levels would indicate microscopic damage, however it has previously been observed that IL-6 levels are increased by contraction of a muscle (Febbraio, Pedersen, 2002). The concentration of IL-6 measured 90 minutes post exercise was still ¼ times lower than that reported for eccentric exercise. The activity of iEMG was significantly greater in the group that performed the exercise with occlusion than in the control group, and this increase in the level of muscle activation with a low level of force production may be related to the intramuscular hypoxic environment in the Which glycolytic motor units are activated to maintain the same level of force generation. The authors concluded that exercise performed with extremely low loading combined with vascular occlusion greatly stimulates GH secretion through the regional accumulation of metabolites without causing considerable tissue damage (Takarada, et al., 2004).

Training with "temporary blood flow occlusion" or Kaatsu has enjoyed increasing popularity in recent years. Although it based on a somewhat disturbing technique based on the restriction of blood flow to the muscle with a tourniquet (Abe, et al., 2006), we can say that Kaatsu can be safely implemented in workouts if observe the Necessary precautions.

When training in conditions of blood occlusion, the following benefits have been observed:

The training with vascular occlusion produces a cross effect, when training a limb by occlusion the opposite extremity benefits from the increase in strength and size.

Although the effect is eminently local (at the level of the restricted muscle), a "contagion" of the effect has been demonstrated towards other groups that intervene in a compound exercise. Thus, although by the nature of the method we must limit the use of tourniquets to the limbs (arm, thighs, twins ...) the adjacent groups seem to experience an added development.

The Kaatsu training is able to generate a great local fatigue by hypoxia in less time than by the traditional techniques of congestion and constant tension, foundations of traditional bodybuilding, with which it can be compared. (Kraemer, et al., 1990).

Conclusions

The findings indicated that the KAATSU training for eight weeks could an improvement in serum protein, Creatinine and performance level of 100m hurdles. These results have to be taken into account by teachers in order to better understand and implicated of these concepts in educational lessons

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