Joint Effects of Kinetic Chains and Aquatic Exercises on the Efficiency of Lower Limps in 50-55 Years Female Patients with Surface Veins Varicose

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Abstract:

The current research aims at identifying the joint effects of kinetic chains and aquatic exercises on the motor efficiency of lower limps in women (50-55 years) with varicose, reflected in leg muscles strength, foot range of motion, balance, ankle perimeter and curve of venous volumetric change. The researchers used the quasi-experimental approach (two-group design) with pre- and post-measurements. Main research sample included (60) women divided into two research groups. Experimental group (n=30) used the recommended program while control group (n=30) used compression socks with apple cider compresses day and night. The recommended program was applied individually on the experimental sample for (9) weeks (4 units per week). The researchers used a goniometry for measuring ankle range of motion, a dynamometer for measuring leg muscles strength, a measuring tap for measuring ankle perimeter, a device for measuring the range of venous volumetric change and Fleishman's test for static balance. Results indicate statistically significant improvements for the experimental group on all research variables (leg muscles strength, foot range of motion, balance, ankle perimeter and curve of venous volumetric change).

Background and Problem:

The current age is characterized by enormous developments in all fields of science. This is due to the industrial revolution and

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technological developments that facilitated physical work and decreased motion. This, in turn, led to decreasing the functional efficiency of vital body systems and the spread of diseases and health and motor problems. Therefore, it is very important to practice physical activity in general and especially rehabilitative kinetic programs to gain more physical and health benefits and to restore normal function of the injured part as all these aspects can protect individuals from diseases related to lack of motion and all its negative effects that appear with aging. (11: 285) (19)

Women represent a major part of the society. They are affected by social developments as they depend more and more on modern equipments in their daily life. This led to serious lack of motion, increase of muscle weakness, gaining more weight and body flabbiness. All these factors affect general health and increased disease rates especially in middle and old age groups, like back pain, arthritis, varicose … etc (23: 56) (11 :285).

Varicose is a swelling that appears on the form of thick zigzag veins full of blood. 10% to 20% of the world's population gets this disease. It appears on the leg surface, ankle and mostly on the calf and thigh as these particular parts are far from the heart. It can hit another body parts like the esophagus. The most common form of varicose hits legs. It is more common among females compared to males (32: 87) (35: 96).

Rmondy,d,silernian ,r (2010) indicated that varicose veins makes superficial veins of the subcutaneous level appear in an expanded, protracted and zigzag form. It is one of the most common vascular diseases as it hits 10-40% of individuals from 30 to 70 years, especially women, elderly and pregnant. Its boredom and medical care costs are enormous (32: 90)

Several studies indicated that varicose veins are more common in females than males as it hits 15% of men and 25% of women. In addition, 50% of women over 50 years have varicose veins. It is very undesirable aesthetically and may cause pain, fatigue and slack. It has several side effects like skin inflammation and spasms. Its causes include high

abdominal pressure due to tumors, repeated pregnancy, obesity, increased venous pressure of the leg due to standing for long times, weak leg muscles, tight clothes, decrease of collagen and alistin that strengthen vein walls and genetic reasons. (1: 12) (25: 15) (14: 68) (3: 45)

Serdenoki (2009) and **Peter Alfy (2011)** indicated that there are three types of veins feeding lower limps with blood. These are superficial veins, deep veins and veins interconnecting the two types. Superficial veins include long and short leg veins while deep veins include dorsal digital veins, anterior and exterior peroneal veins and femoral vein. Interconnecting veins include mid femoral, anterior and exterior veins (36: 133-140) (4: 50)

Vascular efficiency of the lower limps depends on valves that allow blood flow from the foot to the heart and from superficial to deep veins in on direction. Due to varicose, these valves fail to function and this makes blood flow fin the other direction from deep to superficial veins and from the heart to the foot. This increases venous blood pressure and leads to varicose (5: 15) (10: 67)

Mohamed Emam (2002), Kraemer (2004), Shahira Abu Al-Futouh (2007) and Mohamed Gamal el-Din (2012) indicate that leg varicose is divided into a primary type of varicose in the form of blue swelling veins near the surface of the skin and secondary varicose due to phlebemphraxis of deep veins in the legs. This makes he body respond by opening alternative paths so that blood can return back to the heart. Most prominent symptoms of varicose are ankle and foot swelling, leg slack, colored skin, leg itching and calf spasms (15: 40) (28: 223) (12: 15) (17: 20)

Recently, motor rehabilitation has taken a prominent place and a new philosophical dimension as it is no longer limited to caring for sports injuries. Instead, it now focuses on rehabilitating ordinary people of all age groups during medical care and post-operative therapy to restore their physical, motor and functional efficiency of injured parts of the body so that individuals can return,

almost, to normal life during the least possible time (22: 70)

Motor rehab is the key to good results, either in injuries or in diseases. It makes significant improvements t normal functions and supports medical care. Kinetic chains represent the correlation analysis of human biomechanics during various motor exercises and its effects on muscles, bones, joints and nerves. This type of exercises decreases stress and tension in addition to improving balance and decreasing tension of weak muscles. It includes isometric and dynamic exercises that are used in rehab for various injuries and diseases (30: 51) (31: 75) (20)

Aquatic medium is of great significance in rehab due its distinct characteristics like temperature, hydrostatic pressure, buoyancy and density as these factors work on relieving pain and increasing muscle strength and joint flexibility. It helps in achieving protective fitness against diseases due to its wide scope of treatment and care (8: 5) (7: 14)

Lourie (2005) indicated that therapeutic aquatic exercises are more useful than dry land exercises as resistance is the key to success in improving vital systems functionality and strengthening body muscles (29: 55)

The researchers think that caring for women health and problems is a main pillar in any social advance. The Egyptian woman rarely practices regular sports activities. With the increased boredoms of daily life and multiple child bearings, physical problems like hypertension, obesity and varicose increase, in addition to other health problems that affect body motor functions negatively. Through review of literature related to diagnosis, treatment and side effects of varicose (1, 3, 4, 5, 14, 28, 31, 34, 37 and 38), it is clear that this problem gets worse over the time. Several treatments have been used without looking at motor rehab as a recommended therapy. This led the researchers to try to integrate open and closed kinetic chains with aquatic exercises to increase functional efficiency of lower limps in women (50-55 years) with varicose.

Aims:

The current research aims at identifying the joint effects of kinetic chains and aquatic exercises on the motor efficiency of lower limps in women (50-55 years) with varicose, reflected in:

1- Leg muscles strength
2- Foot range of motion
3- Balance
4- Ankle perimeter
5- Curve of venous volumetric change.

Hypotheses:

1. There are statistically significant differences between the pre- and post-measurements of the experimental group on all research variables (leg muscles strength, foot range of motion, balance, ankle perimeter and curve of venous volumetric change) in favor of post-measurements.
2. There are statistically significant differences between the post-measurements of the experimental control groups on all research variables (leg muscles strength, foot range of motion, balance, ankle perimeter and curve of venous volumetric change) in favor of the experimental group.

Methods:

Approach:

The researchers used the quasi-experimental approach (two-group design) with pre- and post-measurements.

Subjects:

Main research sample was purposefully chosen from working women who get treatment with a cardiovascular doctor at Ain Shams specialized hospital, Al-Demardash Hospital and Al-Husain University Hospital. Research community included (70) women (50-55 years) as (60) were chosen and divided into two research groups (control = experimental = 30) while (10) women were excluded due to their medical reports. Pilot sample included (10) women with varicose and (10) healthy women for verification of tests validity and reliability.

Sample members were chosen according to the following criteria:

1. All member were working women who were obliged to stand or sit for prolonged periods of time without any sports activity
2. All members have superficial varicose in primary stages with leg swelling and red skin

3. All members were free of blood clots, sores or cardio-pulmonary diseases. All members with chronic diseases were excluded according to their medical reports.
4. Members with flat-foot were excluded so as not feel early fatigue and exhaustion.
5. All members volunteered and were committed to apply the program to its end.

The researchers homogenized sample members as shown in table (1).

Table (1)
Sample Homogeneity on age, weight and height (n=60)

Variables	Mean	SD±	Squewness
Age	52.70	1.69	-0.206
Height	164.43	3.84	0.005
Weight	76.10	3.18	-0.401

Table (1) indicates that squewness values ranged between 3±. This indicates sample homogeneity.

Data Collection Tools and Equipments:

1. Previous literature related to the topic
2. Tools and devices:

- A restameter for measuring heights (cm)
- A medical balance for measuring weights (kg)
- A goniometry for measuring ankle range of motion (degree)
- A dynamometer for measuring leg muscles strength (kg)
- A measuring tap for measuring ankle perimeter (cm)
- Device for measuring the range of venous volumetric change (ml/l)
- Fleishman's test for static balance (sec)
- A diagnostic colored Doppler (used by a certified physician)
- Power plate device for strengthening lower limps' muscles
- Floating weights, floating vests, hand pedals, fins, and balls, wooden boxes with various heights, matrixes and resistances with various weights.
- Data recording logs for each case

Procedures:

First pilot study:

The researchers performed the first pilot study from 5-1-2012 to 13-1-2012 on

a pilot sample (n=10) from the same research community and outside the main sample, to identify any difficulties that may face main application and to validate tools and equipments, in addition to calculating validity and reliability of tests. Results indicated the validity and reliability of tests. No significant difficulties were noticed during applications. All tools and equipments were valid.

The recommended rehab program:

The recommended rehab program was designed as follows:

1. Review of related literature
2. Experts' opinions (n=9) about the program's bases, contents, stages and implementation
3. Second pilot study: the researchers performed second pilot study on the pilot sample (n=10) to validate the program and identify volume, intensity and rest intervals. The researchers used Karvonen equation (based on pulse rate) to calculate maximum heart rate (HR max=220-age) Performance intensity was identified as between 50% and 70% of HR max (2: 228) (19).

Results of pilot study and experts' opinions are shown in table (2)

Table (2)
General framework of the recommended rehab program

Content	Duration
Timeframe	(9) weeks
Stages	(3)
Units per week	(4)
Total number of units	(36)
Unit duration	Begins with (45) minutes and ends with (60) minutes
Rest intervals	(10) minutes divided across the unit according to individual differences
First stage	(12) unites for (3) weeks (aquatic exercises)
Second stage	(12) unites for (3) weeks (Kinetic chains)
Third stage	(12) unites for (3) weeks (aquatic exercises with kinetic chains)

Table (3)
Contents of the rehab unit

Part	Content	Duration
Warm-up	General preparation exercises for all body parts	5-10 min
Pasic part (aquatic exercises or kinetic chains)	Strength exercises for legs, feet and thigh. Flexibility exercises for ankle. Stretching and balance exercises with equipments. Free exercises considering muscle groups balance	30-45 min
Cool down	Exercises for bringing body back to normal	5 min

Main experiment:

1. Pre-measurements were taken individually for both groups after medical examination and approval of physician
2. The recommended program was applied individually on the experimental sample for (9) weeks (4 units per week). First lady began on 1-3-2012 while last lady finished on 15-9-2012. Control group only used compression socks with apple cider compresses day and night.
3. Post- measurements were taken individually for both groups at the end of the program.

Statistical treatment:

The researcher used SPSS software to calculate mean, SD, squewness, (t) test, Spearman's correlation coefficient and improvement percentage (%).

Results:

Table (4)
Difference significance between pre- and post-measurements and improvement percentage of the experimental group on all research variables (n=30)

Variable		Pre-		Post-		(t)	Significance	(%)
		Mean	SD	Mean	SD			
Muscular strength	Leg muscles	36.20	1.29	46.13	1.16	37.25*	0.00	27.4
Ankle range of motion	Right foot (abduction)	11.60	1.52	15.46	1.16	2.33*	0.00	33.2
	Right foot (adduction)	46.40	1.61	52.20	1.34	47.81*	0.00	12.5

Follow Table (4)

Difference significance between pre- and post-measurements and improvement percentage of the experimental group on all research variables (n=30)

Variable		Pre-		Post-		(t)	Significance	(%)
		Mean	SD	Mean	SD			
	Lift foot (abduction)	11.86	1.56	15.80	1.12	12.82*	0.00	33.2
	Lift foot (adduction)	45.86	1.56	52.0	1.11	24.29*	0.00	13.4
Balance	Right foot	61.40	5.13	92.20	5.96	29.93*	0.00	50.2
	Lift foot	59.66	5.07	91.66	6.60	25.40*	0.00	53.6
Ankle perimeter	Right foot	25.20	1.24	21.13	0.973	32.21*	0.00	16.1
	Lift foot	24.93	1.25	21.06	1.01	29.0*	0.00	15.5
Curve of venous volumetric change	Right foot	27.73	0.926	20.60	0.621	28.50*	0.00	25.7
	Lift foot	27.60	1.10	20.0	0.742	32.62*	0.00	27.5

*** P≤0.05**

Table (4) indicates statistically significant differences between the pre- and post-measurements of the experimental group on all research variables, in favor of the post-measurements.

Table (5)

Difference significance between pre- and post-measurements and improvement percentage of the control group on all research variables (n=30)

Variable		Pre-		Post-		(t)	Significance	(%)
		Mean	SD	Mean	SD			
Muscular strength	Leg muscles	36.0	0.830	35.86	1.04	0.701	0.489	0.38
Ankle range of motion	Right foot (abduction)	11.93	0.944	12.40	1.10	2.08*	0.046	3.9
	Right foot (adduction)	46.13	1.33	46.73	1.72	3.67*	0.001	1.30
	Lift foot (abduction)	11.53	1.04	11.86	0.889	1.90	0.067	2.8
	Lift foot (adduction)	45.33	1.76	45.80	1.54	2.19*	0.037	1.03
Balance	Right foot	60.60	5.75	60.73	5.63	0.205	0.839	0.21
	Lift foot	57.60	5.06	59.20	4.47	4.64*	0.00	2.8
Ankle perimeter	Right foot	25.10	1.02	22.86	1.04	8.55*	0.00	8.9
	Lift foot	24.83	1.31	22.00	1.70	6.12*	0.00	4.11
Curve of venous volumetric change	Right foot	27.53	1.04	27.26	1.01	1.68	0.103	0.98
	Lift foot	27.40	1.10	26.53	1.22	7.54*	0.00	3.2

*** P≤0.05**

Table (5) indicates statistically significant differences between the pre- and post-measurements of the control group on all research variables, except for leg strength, ankle range of motion (lift foot abduction), balance (right foot) and curve of venous volumetric change (right foot) in favor of the post-measurements.

Table (6)
Difference significance between post-measurements of the control and experimental group on all research variables (n=60)

Variable		Control		Experimental		(t)	Significance
		Mean	SD	Mean	SD		
Muscular strength	**Leg muscles**	35.86	1.04	46.13	1.16	35.95	0.00
Ankle range of motion	**Right foot (abduction)**	12.40	1.10	15.46	1.16	10.46	0.00
	Right foot (adduction)	46.73	1.72	52.20	1.34	13.69	0.00
	Lift foot (abduction)	11.86	0.889	15.80	1.12	14.94	0.00
	Lift foot (adduction)	45.80	1.54	52.0	1.11	17.86	0.00
Balance	**Right foot**	60.73	5.63	92.20	5.96	20.99	0.00
	Lift foot	59.20	4.47	91.66	6.60	22.28	0.00
Ankle perimeter	**Right foot**	22.86	1.04	21.13	0.973	6.66	0.00
	Lift foot	22.00	1.70	21.06	1.01	2.58	0.012
Curve of venous volumetric change	**Right foot**	27.26	1.01	20.60	0.621	30.68	0.00
	Lift foot	26.53	1.22	20.0	0.742	24.0	0.00

*** P≤0.05**

Table (6) indicates statistically significant differences between the control and experimental groups on all research variables, in favor of the experimental group.

Discussion:

Table (4) indicates statistically significant differences between the pre- and post-measurements of the experimental group on all research variables, in favor of the post-measurements. Improvement percentage in research variables were as follows: leg muscles strength (27.4%), right foot range of

motion (abduction = 33.2% - adduction = 12.5%), lift foot range of motion (abduction = 33.2% - adduction = 13.4%), balance (right = 16.1% - lift = 15.5%) and curve of venous volumetric change (right = 25.7% - lift = 27.5%). Table (5) indicates statistically significant differences between the pre- and post-measurements of the control group on all research variables, except for leg strength, ankle range of motion (lift foot abduction), balance (right foot) and curve of venous volumetric change (right foot) in favor of the post-measurements. Improvement percentage in research variables were as follows: right foot range of motion (abduction = 3.9% - adduction = 1.3%), lift foot range of motion (adduction = 1.03%), balance (lift = 2.8%) and curve of venous volumetric change (lift = 3.2%).

The researchers think that improvements are due to the recommended rehab program with aquatic exercises and kinetic chains. During the first stage, aquatic exercises provided rehab in a safe medium suitable for varicose.

Thana Al-Bermawy (2003), Gamal Abd El-Haleem (2004) and Binkely (2006) indicated that aquatic exercises help the body moving easily and decrease pressure over joints. This increases the range of motion. Hydrostatic pressure over lower limps increases with increasing depth. This activates blood circulation and decreases swelling and red skin (6) (7) (22) (39).

The researchers think water resistance exercises were very helpful in strengthening leg muscles and controlling total body balance in water due to easy movement in all directions in this dynamic medium.

This is in agreement with **Lourie (2005) and Rhodes (2010)** who indicated that in-water rehab exercises decrease varicose and improve blood circulation efficiency in addition to strengthening lower limps and relieving pressure from its blood vessels (29) (31).

During the second stage, the researchers used closed kinetic chains as feet touch the ground or any other object. This type of exercises decrease muscle tension. Weight bearing exercises improve joint stability and balance. Exercises

also included static and dynamic muscle contractions. In addition, open kinetic chains allow hand and feet to move away from any surface. These exercises improve lower limps flexibility and strength. During the third stage, both types of exercises were used in addition to Power Plate. **Horsfrank (2004) and Bastian (2006)** indicated that this combination provides higher results in a relatively short time as muscle strength, flexibility and blood circulation improve quickly. This helps improving post-measurements of the experimental group (26) (21) (40).

Cooper (2006) indicated that in-water and dry land rehab exercises for varicose increase width of capillaries and speed of blood return to working muscles. This increases the size of muscle fibers and activates blood and lymphatic circulation. It also increases veins flexibility and vein wall strength. This, in turn, improves valves efficiency and prevents venous reflux (24) (43).

The researchers think that minor improvements in the control group are due wearing socks and using apple cider daily as a therapy as this preserves body cells in good condition and prevents worsening varicose.

Abd El-Fattah & Hasanain (2000) indicated that apple cider prevents worsening varicose as it activates blood circulation and provides the body with minerals (potassium, sodium and magnesium) and vitamins (B1, 2 & 6). (2).

Table (6) indicates statistically significant differences between the control and experimental groups on all research variables, in favor of the experimental group. The researchers think that the content of the recommended program (front/back muscles strength exercises and thigh abductor/adductor) improved leg strength. In-water flexibility exercises (horizontal/vertical) helped emptying venous pockets through muscular work.

Several studies like **Doaa Abd El-Azim (2003) and Omar Farouk (2007)** indicate that using aquatic and dry land exercises improves muscular balance as the body moves as a whole. This helps decreasing varicose symptoms and improves blood circulation (9) (14) (41) (42).

Thana Al-Bermawy (2003) and Ayman Abd El-Mohsen (2010) indicated that aquatic exercises in accompaniment with strength, flexibility and balance exercises helps emptying fluids around blood vessels. This decreases pressure and slack of feet in addition to decreasing swelling which, in turn, decreases ankle perimeter gradually (6) (3)

This is in agreement with **Berequaa & Al-Bedewy (2007) and Kathy (2008)** who indicated that flexibility and elastic exercises improve the ankle flexibility and range of motion in all directions. This improves muscles strength and elasticity and produces more effective muscle contractions. Aquatic exercises play a vital role in balancing strength and flexibility (16) (27)

Conclusions:

According to research aims, hypotheses and results, the researchers concluded the following:

1. The recommended rehab program had positive effects on leg muscles strength for the experimental group
2. The recommended rehab program had positive effects on ankle range of motion (abduction/adduction) of the foot (right/lift) for the experimental group
3. The recommended rehab program had positive effects on foot stability (right/lift) for the experimental group
4. The recommended rehab program had positive effects on ankle perimeter (right/lift) for the experimental group
5. The recommended rehab program had positive effects on curve of venous volumetric change of the foot (right/lift) for the experimental group
6. There are statistically significant differences between the pre- and post-measurements of the experimental group on all research variables, in favor of the post-measurements
7. There are statistically significant differences between the pre- and post-measurements of the control group on all research variables, except for leg strength, ankle range of motion (lift foot abduction), balance (right foot) and curve of venous volumetric change (right foot) in favor of the post-measurements.

8. There are significant differences between the control and experimental groups on all research variables, in favor of the experimental group.

Recommendations:

The researchers recommend the following:

1. The recommended rehab program should be applied to prevent varicose from getting worse and to improve the efficiency of the lower limps in women
2. Women, especially workers, should have health education about the dangers of fixed positions (standing – sitting) for prolonged periods of time and they should be encouraged to practice sports activities and exercises regularly
3. Performing more research on the importance of motor rehabilitation in helping individuals with varicose and venous ulcers and in improving the efficiency of lower limps and blood vessels in men and women

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