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Efficacy of underwater exercises on Egyptian Children with Juvenile Idiopathic Arthritis

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Abstract: Background: Juvenile idiopathic arthritis (JIA) is one of the serious chronic rheumatic disorders in children and adolescents which results in less physical activities and restlessness hours than their peer. **Purpose**: The study aimed to detect the effect of underwater exercise program on aerobic capacity and muscular strength in Egyptian children with JIA. **Methods**: seventy children from both sexes with oligo-articular JIA, they were randomly divided in two equal groups control group received exercise training protocol, study group received the same exercise training protocol in addition to hydrotherapy exercise session three times per week for three successive months. Evaluation was done pre and post interventions included: peak oxygen uptake (Vo2 peak) and muscle strength assessed by isokinetic testing device. **Results**: There is significant improvement in mean values of the measured variables including peak oxygen uptake (Vo2 peak) peak torque of knee extensors and flexors of both lower limbs during the concentric contraction mode, and peak torque of wrist extensors and flexors of both upper limbs during the concentric contraction mode with the advantage of the study group. **Conclusions**: The results of the study suggested that children with JIA when participated in under water exercises this may enhance equality of life in children with JIA.

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Keywords: Juvenile idiopathic arthritis; peak oxygen consumption; isokinetic testing.

1. Introduction

Juvenile idiopathic arthritis (JIA) is one of the common childhood disorders that affect around one in 1,000 children. It's diagnosed early under the age of 16 with arthritis in one or more joints and persists for at least six weeks. [1] The main clinical presentations are lack of joint movement, pain, and swelling of the involved joints. [2] The course of JIA may become more intense and continues throughout adulthood increasing cardiovascular risk, osteoporosis, and obesity in this period of lifespan. [3, 4] Physical deconditioning is seen in children with JIA as a consequence of weak musculature, joint pain, contracture and lower peak oxygen uptake (Vo2 peak). [5, 6]

Abdul-Sattar et al. [7] conducted a study on Egyptian children and adolescents patients of JIA with age more than seven years and duration of disease exceeds one year to explore the factors that may contribute to increase the rate of absenteeism and lack of functioning at school. They found that these factors are the amount of inflammation present, the level of functional disability, and psychological deconditioning.

Physical therapy was instituted for patients with JIA to promote lifetime physical activity through controlling pain and inflammation, maintaining range of motion (ROM) and muscle strength that play important role in increasing joint stability. [8]

It was found that patients got more improvements in their functional abilities than those who live a standard life care if they joined exercises in form of aerobic conditioning, strengthening and sport activities. [9] No previous studies investigated the effect of underwater exercise program on aerobic capacity and muscular strength in Egyptian children with JIA using validated measures Therefore, this study was conducted to assess the efficacy of underwater exercise program on the aerobic capacity and muscle strength of Egyptian children with JIA.

2. Material and Method

Seventy Egyptian children with JIA participated in this study. Their ages ranged from eight to twelve years.

Children with JIA were recruited from Abo-Elrish Hospital and the pediatrics out-patient clinic, faculty of physical therapy, October 6University hospital. They were involved in a training program three times per week for three successive months. The study extended from January 2016to April 2018.

The children's parents signed a written consent form that was approved by the ethical committee for research studies, The JIA children were enrolled according to the following:

2.1. Inclusion criteria:

1) Medical diagnosis of JIA was conducted by a pediatric rheumatologist in agreement the criteria of international league against rheumatology. [10]

2) Children were able to communicate verbally and obey commands and instructions and co-operate with testing and training protocols.

2.2. Exclusion criteria:

- Children complained from severe pain according to verbal pain intensity scale. [11]
- Children had cardiac, pulmonary or metabolic disease.
- Children had active features of systemic arthritis.
- Children had fixed deformity (bony or soft tissue contracture) of both upper and lower limbs.
- Children had previous surgical interventions which may include soft tissues release, synovectomies, arthrodeses, and joints replacements.
- Children had visual or auditory defects.

3. Instrumentation

3.1 For evaluation

- Weight and height scale: to calculate the body mass index were measured using an electronic scale (Human body Element Analyzer system, Korean).
- Verbal rating scale for pain to assess pain intensity [12].
- Cardiopulmonary function test via electrocardiograph (ECG) Nihon Kodhen Cardiofax Engospirometry with integrated stress–ECG (Model: ISSOK, manufactured by Nihon-Kohden, Japan). Engospirometry is the most comprehensive test of cardiopulmonary analysis. The peak oxygen uptake (Vo2 peak) was measured during instrumental treadmill exercise testing. The ECG was used first at rest and during activity to record heart rate and blood pressure.
- isokinetic dynamometer (TUR GmbH, Berlin, Germany): was used to assess the isokinetic muscular performance.

3.2. For intervention

- Hubbard tank (HUBBARDOV KUPEL N0089/2016 SLOVAK REPUBLIC) at the outpatient clinic, faculty of physical therapy, October 6 University, Egypt. The tank supplied with lifter.
- Bicycle ergometer (TUV/GS:En 957-5, Class A, Taiwan). It is an electronically braked ergometer with a screen to check the child's heart rate and helps the therapist to control exercise intensity.
- Treadmill apparatus (Biodex Gait Trainer 2TM, Shirly, USA) was used for fitness training.
- Exercise balls and thera-band (elastic band) were used to provide resistance.

3.3. Procedures for evaluation

- Cardiopulmonary capacity testing was done using engospirometry with integrated stress ECG while the child practicing on treadmill. The test was carried on an anticipation of volitional fatigue regardless verbal encouragements. [12] This procedure has been established as a reliable test in previous studies. [13, 14] The O2 uptake and Co2 production were analyzed. The test room temperature was fixed at 20-28° C and 40% relative humidity of air to decrease the thermal stresses. The children were instructed to have a light breakfast two hours prior the exercise testing.
- Isokinetic dynamometer.
- Testing muscle performance of knee flexion and extension:

Each child was tested in an erect posture while sitting on the dynamometer with his/her hip and knee flexed 90°. The child was strapped to the seat by a wide belt that held to the pelvis, by chest straps and by a horizontal strap over the middle third of the thigh just above the knee to prevent any extra movements or substitutions that would affect the measurements. All subjects performed a preliminary test to be familiarized with the equipment and testing protocol. The testing procedure consisted of 10 knee extension and flexion repetitions for each lower extremity at slow regular speed (60 °/sec) and at angular speed (120 °/sec).

- Testing the muscular performance of wrist extension and flexion:

Each child was tested with the back fully supported in the seated position. The child was strapped to the seat with a wide belt that held the pelvis and by a chest strap and a horizontal strap just below the elbow joint to prevent any substitutions that would affect the measurements. The child's forearm was pronated because a greater mean torque can be produced than in supination. All subjects performed a preliminary test to familiarize them with the equipment and testing protocol. Peak wrist extension and flexion torques were recorded. [15] The testing procedure consisted of 10 wrist extension and flexion repetition for each hand at slow angular speed (60 °/sec) and at fast angular speed (120 °/sec). [16]

3.4. Procedures for physical intervention for the study and control groups

Treatment procedures

1-Treatment for control group:

Patients of the control group received exercise training protocol included a bicycle ergometer, treadmill and strengthening exercises for one hour per session, three times per week for three successive months including:

A- Bicycle ergometer training.

- The child got explanation of the goals and procedures before pedaling.
- Any restricted clothes were removed to facilitate the performance of the exercise.
- The child was asked to sit erect on the seat of the bicycle grasping the bicycle handles and the feet strapped with the pedals.
- The bicycle was settled on a climb steady program in which the resistance increased gradually.
- The speed was settled on that of the habituation session then continued at 60-100 revolutions per minute.
- The child was asked to complete pedaling on the bicycle ergometer for eight minutes in week one, with the duration increases by two minutes each week until week six. Then at the week 6-12, the program lasted for 20 minutes. [17]

B- Treadmill training.

- The goal of exercise and the procedure were made clear to the child before standing training on the treadmill.
- Any restricted clothes were removed to allow walking without difficulty. The child was asked to firmly grasp the treadmill bars by both hands and keep looking forward.
- The initial speed and slope were determined at the habituation session. Then the speed kept between 1.5 and 3 km/hr.
- The child was instructed to keep walking on the treadmill for eight minutes in week one, with the duration increased by two minutes each week until week six. At the week six to 12; the program lasted for 20 minutes. [18]

C- Strengthening exercises.

Strength training exercise involved progressive upper and lower limbs exercise program in form of static and dynamic exercises using exercise balls, soft weights, thera-bands, elastic bands. Exercises concentrated on the shoulder flexors, abductors, external rotators, elbow flexors and extensors, wrist flexors and extensors, hip flexors and extensors, abductors and adductors, knee flexors and extensors, ankle dorsi and plantar flexors, abdominal muscles and back muscles. The intensity of exercise was determined during habituation testing session according to the maximum weight (a repetition maximum (1 RM)) that the child can lift through the available ROM just for one time. In weeks 1-6, the focus was on a 0.25 RM for 10 repetitions. In week 7-12, the focus was on a 0.5 RM for 20 repetitions. [19]

-Treatment for study group:

In this group patients received the previous selected physical therapy program in addition to hydrotherapy session three times per week for three successive months.

Hydrotherapy session:

A well expert physical therapist performed the aquatic exercises. Before starting the program the following factors were settled; water temperature (32-34°C), room temperature (20-22°C) and air temperature of the tank area was 25°C.

The program included warming up activities consisted of ROM and light stretching exercises to relax stiff joints and get the children ready for further exercises. A structured program extended for 30 minutes in the form of jogging, Strength training exercise involved progressive upper and lower limbs exercise program in form of static and dynamic exercises using exercise balls, soft weights and Proprioception training (stand on one foot on). [20,21]

At the end of the session, the child got out the tank, took a neutral shower (25°C), then waited for 15 minutes in the changing room (22°C) and drunk a juice before participation in the land–based training program.

4- Results

The gathered data represent the statistical analysis of peak oxygen uptake, peak torque of knee extensors and flexors of both lower limbs and peak torque of wrist extensors and flexors of both upper limbs during the concentric contraction mode.

No statistically significant differences were detected between both groups regarding mean values of age and body mass index (BMI) between study and control groups **(Table 1).**

Table 1. Subjects' characteristics of study and control groups.

Variables	Study group (n=35)	Control group (n=35)	p-value
Age (yrs)	10.13 (1.3)	10.0 (1.2)	0.6651
BMIb (Kg/m^2)	17.23 (2.85)	18.82 (4.22)	0.0691

Values indicated mean (Standard deviation), a **χ2**-test, b Independent t-test. * Significant

Before intervention

In comparison of pre-intervention values of peak oxygen uptake, peak torque of knee extensors and flexors, and peak torque of wrist extensors and flexors, there were no statistically significant differences of means between study and control groups ($p < 0.05$) **(Table 2).**

After intervention

When comparing the measuring parameters before and after completion of the training program. There were significant differences in Vo2 peak, peak torque of knee extensors and flexors and peak torque of wrist extensors and flexors in the control group **(Table 3)**. While similar results were obtained in the study group regarding all studied parameters. **(Table 4)**

Table 2. Pre-intervention assessments' mean values of the Study group and control groups

Parameters	Pre intervention of study group (SD)	Pre intervention of control group Mean (SD)	MD	t-value	p-value
VO_2 peak ml/kg/min)	29.41(4.67)	31.2 (3.6)	1.79	1.7959	0.0769
Peak torque of knee extensors (Nm) at 60°					
Right	41.93(2.88)	43.41 (4.2)	1.48	1.7193	0.0901
Left	40.8 (0.8)	41.0 (1.5)	0.2	0.6960	0.4888
Peak torque of knee extensors (Nm) at 120°					
Right	35.7(2.4)	36.4 (1.87)	0.7	1.3611	0.1780
Left	35.4(2.3)	36.2 (3.5)	0.8	1.1301	0.2624
Peak torque of knee flexors (Nm) at 60°					
Right	19.26(1.7)	20.87(4.7)	1.61	1.9057	0.0609
Left	18.9(1.6)	20.6 (5.2)	1.7	1.8486	0.0689
Peak torque of knee flexors (Nm) at 120°					
Right	16.5(4.9)	18.6 (4.5)	2.1	1.8674	0.0662
Left	16.4(5.2)	18.6 (4.8)	2.2	1.8392	0.0703
Peak torque of wrist extensors (Nm) at 60°					
Right	3.76 (2.7)	4.08(2.8)	0.80	1.6158	0.1108
Left	3.93 (1.78)	3.93 (1.78)	1.32	1.8854	0.0637
Peak torque of wrist extensors (Nm) at 120°					
Right	2.86 (2.44)	3.14(2.44)	0.96	1.8365	0.0707
Left	2.89 (1.55)	3.11(1.55)	0.87	1.7004	0.0936
Peak torque of wrist flexors (Nm) at 60°					
Right	5.25 (3.8)	5.13(3.4)	2.14	1.8831	0.0640
Left	4.4 (2.87)	4.9(2.55)	1.88	1.9445	0.0560
Peak torque of wrist flexors (Nm) at 120°					
Right	3.81 (1.92)	4.3(1.65)	1.8	1.9184	0.0593
Left	3.75(1.25)	4.12(0.89)	1.58	1.9744	0.0524

SD, Standard Deviation; MD, Mean difference; P-value, probability level, *, Significant

Table 3. Comparison between Pre and Post-intervention assessments' mean values of the control group.

Parameters	Pre intervention Mean (SD)	Post intervention Mean (SD)	MD	t-value	p-value
VO_2 peak (ml/kg/min)	31.2 (3.6)	33.2(1.67)	2.0300	2.9815	0.0040***
Peak torque of knee extensors (Nm) at 60°					
Right	43.41 (4.2)	45.75 (2.58)	2.34	2.8085	0.0065***
Left	41.0 (1.5)	42.48 (2.88)	1.48	2.6964	0.0088***
Peak torque of knee extensors (Nm) at 120°					
Right	36.4 (1.87)	37.65 (1.46)	1.25	3.1171	0.0027***
Left	36.2 (3.5)	38.2 (2.5)	2	2.7509	0.0076***
Peak torque of knee flexors (Nm) at 60°					

Parameters	Pre intervention Mean (SD)	Post intervention Mean (SD)	MD	t-value	p-value
Right	20.87(4.7)	23.7 (3.6)	2.7	2.8280	0.0061***
Left	20.6 (5.2)	24.15 (5.7)	3.55	2.7220	0.0082***
Peak torque of knee flexors (Nm) at 120°					
Right	18.6 (4.5)	21.8 (4.12)	3.2	3.1029	0.0028***
Left	18.6 (4.8)	22.14 (4.4)	3.54	3.2163	0.0020***
Peak torque of wrist extensors (Nm) at 60°					
Right	4.08(2.8)	6.16 (2.4)	2.08	3.3368	0.0014***
Left	3.93 (1.78)	7.45 (1.78)	3.52	8.2726	0.0001***
Peak torque of wrist extensors (Nm) at 120°					
Right	3.14(2.44)	5.2(1.5)	2.06	4.2550	0.0001 ***
Left	3.11 (1.55)	5.72 (2.1)	2.61	5.9159	0.0001***
Peak torque of wrist flexors (Nm) at 60°					
Right	5.13(3.4)	10.2(2.25)	5.07	7.3569	0.0001***
Left	4.9(2.55)	8.85(2.41)	4.95	8.3464	0.0001***
Peak torque of wrist flexors (Nm) at 120°					
Right	4. 3(1.65)	8.68 (1.44)	4.38	11.8322	0.0001***
Left	4.12(0.89)	7.94 (1.21)	3.82	15.0456	0.0001***

SD, Standard Deviation; MD, Mean difference; P-value, probability level, *, Significant

Table 4. Comparison between Pre and Post-intervention assessments' mean values of the study group.

Parameters	Pre intervention Mean (SD)	Post intervention Mean (SD)	MD	t-value	p-value
VO_2 peak (ml/kg/min)	29.41(4.67)	34.98(3.23)	5.57	6.95	0.001*
Peak torque of knee extensors (Nm) at 60°					
Right	41.93(2.88)	64.7(4.16)	22.77	28.4	0.0001*
Left	40.8(0.8)	63.8(4.5)	23	29.62	0.0001*
Peak torque of knee extensors (Nm) at 120°					
Right	35.7(2.4)	48.9(2.74)	13.2	16.48	0.0001*
Left	35.4(2.3)	48.4(2.9)	13	16.23	0.0001*
Peak torque of knee flexors (Nm) at 60°					
Right	19.26(1.7)	36.83(2.9)	17.57	21.94	0.0001*
Left	18.9(1.6)	35.9(2.6)	17	21.23	0.0001*
Peak torque of knee flexors (Nm) at 120°					
Right	16.5(4.9)	31.7(2.4)	15.2	12.97	0.0001*
Left	16.4(5.2)	30.8(2.1)	14.4	11.80	0.0001*
Peak torque of wrist extensors (Nm) at 60°					
Right	3.76 (2.7)	6.74(1.2)	2.98	4.6653	0.0001*
Left	3.93 (1.78)	6.55(1.1)	2.62	5.95	0.0001*
Peak torque of wrist extensors (Nm) at 120°					
Right	2.86(2.44)	5.17(0.8)	2.31	4.095	0.0001*
Left	2.89 (1.55)	5.12(0.7)	2.23	6.071	0.0001*
Peak torque of wrist flexors (Nm) at 60°					
Right	5.25(3.8)	14.18(2.6)	9.05	10.2928	0.0001*
Left	4.4(2.87)	14.3(2.5)	9.4	13.243	0.0001*
Peak torque of wrist flexors (Nm) at 120°					
Right	3.81(1.92)	12.9(1.9)	8.6	17.5947	0.0001*
Left	3.75(1.25)	12.3(2.3)	8.18	18.8193	0.0001*

SD, Standard Deviation; MD, Mean difference; P-value, probability level, *, Significant

In **(Table 5)**, there were significant differences obtained in Vo2 peak, peak torque of knee extensors, peak torque of knee flexors peak, peak torque of wrist flexors and peak torque of left wrist extensors at 60 degree. While no significant differences were obtained between both groups for peak torque of right wrist extensors at 60 degree and peak torque of wrist extensors at 120 degree.

Table 5. Comparison between Post-intervention assessments' mean values of the study group and control group.

Parameters	Post intervention Control group mean (SD)	Post intervention Study group Mean (SD)	MD	t-value	p-value
VO_2 peak (ml/kg/min)	33.2(1.67)	34.98(3.23)	1.78	2.8961	0.0051 ***
Peak torque of knee extensors (Nm) at 60°					
Right	45.75 (2.58)	64.7(4.16)	18.95	22.9024	0.0001*
Left	42.48 (2.88)	63.8(4.5)	21.32	23.6081	0.0001*
Peak torque of knee extensors (Nm) at 120°					
Right	37.65 (1.46)	48.9(2.74)	11.25	21.4371	0.0001 ***
Left	38.2 (2.5)	48.4(2.9)	10.2	15.7604	0.0001 ***
Peak torque of knee flexors (Nm) at 60°					
Right	23.7 (3.6)	36.83(2.9)	13.13	16.8034	0.0001***
Left	24.15 (5.7)	35.9(2.6)	11.75	11.0956	0.0001***
Peak torque of knee flexors (Nm) at 120°					
Right	21.8 (4.12)	31.7(2.4)	9.9	12.2837	0.0001***
Left	22.14 (4.4)	30.8(2.1)	8.66	10.5084	0.0001***
Peak torque of wrist extensors (Nm) at 60°					
Right	6.16(2.4)	6.74(1.2)	0.58	1.2788	0.2053
Left	7.45(1.78)	6.55(1.1)	0.90	2.5446	0.0132***
Peak torque of wrist extensors (Nm) at 120°					
Right	5.2(1.5)	5.17(0.8)	0.03	0.1044	0.9172
Left	5.72(2.1)	5.12(0.7)	0.60	1.6036	0.1134
Peak torque of wrist flexors (Nm) at 60°					
Right	10.2(2.25)	14.18(2.6)	3.98	6.8480	0.0001***
Left	8.85(2.41)	14.3(2.5)	5.45	9.2852	0.0001***
Peak torque of wrist flexors (Nm) at 120°					
Right	8.68(1.44)	12.9(1.9)	4.22	10.4721	0.0001***
Left	7.94(1.21)	12.3(2.3)	4.36	9.9251	0.0001***

SD, Standard Deviation; MD, Mean difference; P-value, probability level, *, Significant

6. Discussion

It was established that JIA leads to physical deconditioning and low quality of life experience. [22,23]

According to the world health organization (WHO), a limitation in activities on a restriction in activity participation with peers is included in the definition of disability. [24]

This study attempted to test the effect of underwater exercises program for Egyptian children with juvenile idiopathic arthritis and to investigate if that designed program might improve the physical fitness and life satisfaction of children with arthritis.

Previously Jasso *et al.* [25] compared the physical work capacity of children with JIA as determined by measurement of maximal oxygen uptake with that of children without JIA. Children with JIA were found to be significantly less fit than their age-matched controls. They concluded that the amount of physical work that children with JRI are able to accomplish is related to the severity of their articular disease. This research also established that children with JRI have a problem in maintaining normal levels of physical fitness.

As engaged joints are habitually kept in a comfort flexion position, these lead to delayed neuromuscular development, muscular weakness, ligamentous laxity, and generalized or localized growth disturbances. [26]

The pre-intervention Vo2 peak mean values of the JIA group and control group indicated that there is no statistically significant difference in cardiopulmonary capacity. Also the isokinetic muscle performance for the knee and wrist joints of the JIA group and control group indicated that no statistically significant difference between groups.

After three sessions per week for three successive months the cardiopulmonary capacity was calculated for both the control group and the study group with the advantage of the study group. Also Results of This study revealed significant improvement in mean values of the measured variables including peak torque of knee extensors and flexors of both lower limbs during the concentric contraction mode, and peak torque of wrist extensors and flexors of both upper limbs during the concentric contraction mode.

These improved results of the study group may be attributed to the effect of underwater exercise as a buoyancy of water makes it a favorable choice for patients with muscular and joint disease. This May be also due to the effects of hydrostatic pressure of the water.

Somaia et al. [27] Explain the effects of water on muscle strength.

That hydrostatic pressure of the water assist participant to exercise more vigorously with less strain on the musculo-skeletal and cardiovascular systems resulting in enhanced venous and lymphatic return that can help to reduce swelling in extremities another explanation can be drawn out that the effects of viscosity can create equal amounts of resistance on all planes of motion. High water viscosity helps the participants to work with opposite group of muscles at the same time with the same amount of resistance using single exercise program meaning that the body meets resistance in all directions of movement to create better resistance program between different muscle groups this comes in agreement with.

Also this comes in agreement with Brawley and Culos-Reed [28] who reported that patients with arthritis benefited from aquatic exercises as the pain decreased, the muscle strength increased, the joint ROM improved, and the aerobic capacity is raised.

And This was consistent with the findings of Nolte *et al.* [29] who revealed that Land-based exercises if combined with water-based exercises resulted in a positive influence on the physical conditioning of joint diseased patients with the beneficiary of water-based exercises in reducing joint swelling.

Improvement of the mean values of the peak torque of knee extensors and flexors of both lower limbs during concentric contraction mode of the both groups may be due to treadmill training. On the treadmill moving surface helped the children to spend more time with their feet on the surface during the walking cycle than when they walked over ground. [30]

This comes in agreement with Tulchin *et al.* [31] who disclosed that treadmill training increases walking endurance, muscle action, aerobic fitness and balance.

The treadmill stimulates weight bearing on the lower extremities in upright posture through repetitive and rhythmic stepping which on turn improve gait pattern. Four weeks of treadmill training associated with muscle strength training are supposed to improve push–off power generation and speed of locomotion. [32]

Moreover the improved post-intervention values of the muscle strength of the both groups may be attributed to cyclic ergometer exercises. Ergometer requires active contribution of muscles of the lower limbs. [33]

Physiologically the ergometer stimulates the gait generating circuitry in the spinal cord which facilitates affected leg muscles in a more nearly normal temporal rhythm. [34]

Pedaling is considered as an aerobic exercise utilizes alternate agonist and antagonist muscles' contraction of the lower limbs in repetitive functional activity as that required for walking. [35]

The increased muscle strength of the upper and lower limbs of the both groups after physical therapy intervention program may be attributed to the effect of strength training exercises as strengthening exercises offer enough resistance or overload which result in increased recruitment of the muscle fibers. Efficient muscular strength and endurance play important role in shock absorption and joint protection in weight bearing activities. [36, 37]

When comparing between both groups for peak torque of right wrist extensors at 60 degree and peak torque of wrist extensors at 120 degree there is no significant differences were obtained this may be results from that under water exercises was emphasis on training of lower limbs.

7. Conclusions

The results of the study suggested that children with JIA when participated in under water exercises this may enhance quality of life in children with JIA.

Reference

1. Manners PJ, Bower C. Worldwide prevalence of juvenile arthritis: why does it vary so much? J Rhematol 2002; 29:1520-30.
2. Merino R, de Inocencio J, Garcia-Consuegra J. Evaluation of revised International League of Associations for Rheumatology classification criteria for juvenile idiopathic arthritis in Spanish children (Edmonton, 2001). J Rheumatol 2005; 32: 390-2.
3. Packham JC, Hall MA. Long-term follow-up of 246 adults with juvenile idiopathic arthritis functional outcome. Rheumatology (Oxford) 2002; 41:1428-35.
4. Oen K, Duffy CM, Tse SM, Ramsey S, Ellsworth J, Chedeville G, *et al.* Early outcomes and improvement of patients with juvenile idiopathic arthritis enrolled in a Canadian multicenter inception cohort. Arthritis Care Res (Hoboken) 2010; 62:527-36.
5. Henderson CJ, Lovell DJ, Specker BL, Compaigne BN. Physical activity in children with juvenile rheumatoid arthritis: quantification and evaluation. Arthritis Care Res1995; 8:114-9.
6. Takken T, Hemel A, van der Net J, Helders PJ. Aerobic fitness in children with juvenile idiopathic arthritis: a systematic review. J Rheumatol2002; 29: 2643-7.
7. Abdul-Sattar AB, Elewa EA, El-Shahawy Eel-D, Waly EH. Determinants of health related quality of life impairment in Egyptian children and adolescents with juvenile idiopathic arthritis: Sharkia Governorate. Rheumatol Int 2014; 34: 1095-101.
8. Wmight Y, Smith E. PT management of children with juvenile rheumatoid arthritis. In: Walker MJ and A. Helewa editors. Physical therapy in arthritis. New Jersey: W Sannders Publishers; 1996. p. 211-63.
9. Kuntze G, Nesbitt C, Whittaker JL, Nettel-Aguirre A, Toomey C, Esau S, Doyle-Baker PK, Shank J, Brooks J, Benseler S, Emery CA. Arch Phys Med Rehabil 2018; 99:178- 193.e1.
10. Merino R, de Inocencio J, García-Consuegra J. Evaluation of revised international league of associations for rheumatology classification criteria for juvenile idiopathic arthritis in Spanish children (Edmonton 2001). J Rheumatol 2005: 32: 559-61.
11. ten Klooster PM, Vlaar AP, Taal E, Gheith RE, Rasker JJ, El-Garf AK, van de Laar MA. The validity and reliability of the graphic rating scale and verbal rating scale for measuring pain across cultures: a study in Egyptian and Dutch women with rheumatoid arthritis. Clin J Pain 2009; 22: 827-30.
12. Andreacci JL, LeMura LM, Cohen SL, Urbansky EA, Chelland SA, Von Duvillard SP. The effects of frequency of encouragement on performance during maximal exercise testing. J Sports Sci 2002; 20: 345-52.
13. Giannini MJ, Protas EJ. Exercise response in children with and without juvenile rheumatoid arthritis: a case-comparison study. Phys Ther 1992; 72: 365-72.
14. Takken T, van der Net J, Helders PJ. Aerobic exercise testing in juvenile rheumatoid arthritis in patients. Clin Exerc Physiol 2002; 4: 38-43.
15. Millar LE, Pierson LM, Nickols-Richardson SM, Wootten DF, Selmon SE, Ramp WK, Herbert WK. Knee extensor and flexor torque development with concentric and eccentric isokinetic training. Res Q Exerc Sport 2006;77: 58-63. 304.
16. De Ste Croix M, Deighan M, Armstrong N. Assessment and interpretation of isokinetic muscle strength during growth and maturation. Sports Med 2003; 33: 727-43.
17. Sharma S, Gupta A. Methodology for study of the effect of cyclic ergometer exercise on improving gait parameters in ambulatory spina bifida children. JEPA 2011; 1: 109–17.
18. Danielesson A, Sunnerhagen KS. Oxygen consumption during treadmill walking with and without body weight support in patient with hemiparesis after stroke and in healthy subjects. Arch Phys Med Rehabil 2000; 81: 953-57.
19. Stenstorm CH, Minor MA. Evidence for the benefit of aerobic and strengthening exercises in rheumatoid arthritis. Arthritis Rheumatol 2003; 49: 428-34.
20. Bacon MC, Nicholson C, Binder H, White PH. Juvenile rheumatoid arthritis: aquatic exercise and lower extremity function. Arthritis Care Res 1991; 4: 102-5.
21. Takken T, Van Der Net J, Kuis W, Helders PJ. Aquatic fitness training for children with juvenile idiopathic arthritis. Rheumatology (Oxford) 2003; 42: 1408-14.
22. Gutierrez-Suarez R, Pistotrio A, Cespedes Cruz A, Norambuena X, Flato B, Rumba I *et al.* Health-related quality of life of patients with juvenile arthritis coming from 3 different geographic areas. The PRINTO multinational quality of life cohort study. Rheumatology (Oxford) 2007; 46: 314-20.
23. Ruperto N, Ravelli A, Pistorio A, Malattia C, Cavuto S, Gado-West L, *et al.* Pediatric Rheumatology International Trials Organization. Cross-cultural adaptation and psychometric evaluation of the Childhood Health Assessment Questionnaire (CHAQ) and the Child Health

Questionnaire (CHQ) in 32 countries. Review of the general methodology. Clin Exp Rheumatol 2001; 19: S1-9.
24. Metin G, Oztürk L, Kasapçopur O, Apelyan M, Arisoy N. Cardiopulmonary exercise testing in juvenile idiopathic arthritis. J Rheumatol 2004; 31: 1834-9.
25. Jasso M, Protas EJ, Giannini EH, Brewer EJ. Physical Work Capacity (PWC) in Juvenile Rheumatoid Arthritis (JRA) Patients and Health Children. J Rheumatol 1986; 13: 977.
26. Klepper SE. Exercise and fitness in children with arthritis: evidence of benefits for exercise and physical activity. Arthritis Rheumatol 2003; 49: 435-43.
27. Somaia A. Hamed, Mohamed A. El-Markby and Ibrahim M. Zoheiry, Effect of underwater resistive exercise in post burned children, international journal of therapies and rehabilitation research Jan 2016.
28. Brawley LR, Culos-Reed SN. Studying adherence to therapeutic regimens: overview, theories, recommendations. Control Clin Trials 2000; 21: 156S-63S.
29. Nolte K, Janse van Rensburg DC, Krüger PE. Land and water based exercises in rheumatoid arthritis patients: a series of case reports. SAJSM 2011; 23: 84-8.
30. Warabi T, Kato M, Kiriyama K, Yoshida T, Kobayashi N. Treadmill walking and over ground walking of human subjects compared by recording sole-floor reaction force. Neurosci Res 2005; 53: 343-8.
31. Tulchin K, Orendruff M, Karol L. A comparison of multi-segment foot kinematics during level over ground and treadmill walking. Gait Posture 2010; 31: 104-108.
32. Mohamed RA, Sherief AA. Bicycle ergometer versus treadmill on balance and gait parameters in children with hemophilia. Egypt J Med Hum Genet 2015; 16: 181-7.
33. Sharma S, Gupta A. Methodology for the study of the effect of cyclic ergometer exercise on improving gait parameters in ambulating spina bifida children. IJEPA 2011; 1: 109-117.
34. Benecke R, Conrad B, Meinck HM, Höhne J. Electromyographic analysis of bicycling on an ergometer for evaluation of spasticity of lower limbs in man. Adv Neurol 1983; 39: 1035-46.
35. Raasch C, Zajac FE. Locomotor strategy for pedaling muscle groups and biomechanical functions. J Neurophysiol 1999; 82: 515-25.
36. Komatireddy GR, Leitch RW, Cella K, Browning G, Minor M. Efficacy of low load resistive muscle training with rheumatoid arthritis functional class II and III. J Rheumatol 1997; 24: 1531-9.
37. Häkkinen A, Sokka T, Kotaniemi A, Hannonen P. A randomized two-year study of the effects of dynamic strength training on muscle strength, disease activity, functional capacity, and bone mineral density in early rheumatoid arthritis. Arthritis Rheumtol 2001; 44(3), 515-22.

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