

## Effect of TRX Suspension Training on Technical Performance for Artistic Swimming Figures

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### Abstract:

Artistic swimming is a demanding sport which requires exclusive aquatic skills; strength, power, endurance, coordination abilities, stability, joints flexibility, bouncy factor and grace artistry. The swimmers compete by executing a specific “figure competition”, in which the athletes perform a set of mandatory or optional figures, and they are judged regarding the accuracy of positions. This sport requires athletes to have a high level of physical training, mastery of complex technical skills, and artistry.

Suspension Training exercise is purported to have an effective role in develop strength, flexibility, and core strength simultaneously. It requires the use of the TRX Suspension Trainer, a highly portable performance training tool that leverages gravity and the user’s body weight to complete hundreds of exercises.

**The aim of study:** to determine the effect of TRX suspension Training on Technical Performance for Artistic Swimming Figures. **Methods:** 7 female subjects age  $14.1 \pm 0.89$  were selected to participate in this study were assigned to one experimental group, participated in 8 weeks as strength, core muscle strength and flexibility, Synchro land and Specific water exercises in addition to routine training. **Results:** positive influence pre- and post-applied TRX training exercises as Ariana element pre mean  $4.09 \pm 0.65$ , post mean  $4.74 \pm 0.49$  and Rio element pre mean  $3.51 \pm 0.85$ , post mean  $4.44 \pm 0.73$ . **Conclusion:** provide evidence for the benefit of integrating TRX suspension training in dryland exercises for strength, core strength and flexibility that are improve the quality of the figures performance.

**Keywords:** Artistic Swimming, figures, TRX suspension training

## المخلص:

تتطلب رياضة السباحة الفنية تدريب شديدة الجدية لما تتميز به من العديد من المهارات داخل الوسط المائي؛ كما انها تتطلب مستوى عال من التدريب البدني من القوة والقدرة والتحمل والتوافق والتوازن ومرونة المفاصل وأيضا البراعة الفنية وغيرها من الجوانب. يتنافس اللاعبات في بطولة الحركات Figures من خلال مجموعة من العناصر الاجبارية والاختيارية ، ويتم تقييم اللاعبات علي دقة الاداء الفني للاوضاع الاساسية للمهارة.

ويعتبر التدريب باستخدام أداة التعليق له دور فعال في تطوير القوة العضلية والمرونة وقوة الجزء المركزي في شكل متزامن مما له فوائد للعضلات المطلوبة. يهدف البحث الي التعرف علي تأثير تدريبات التعليق TRX على الاداء الفني للحركات في السباحة الفنية. استخدمت الباحثة المنهج التجريبي نظراً لملائمة لطبيعة البحث وذلك لمجموعة واحدة بإتباع القياسات القبلية والبعدي لعينة البحث . أشتملت عينة البحث على لاعبات السباحة الفنية والبالغ قوامهم (7) لاعبات، واللاتي يتراوح أعمارهن  $14.1 \pm 0.89$  سنوات، تراوحت مدة البرنامج الي ثمانية أسابيع . وقد أظهرت النتائج ان التدريبات باستخدام أداة التعليق TRX خارج وداخل الماء له فوائد من حيث القوة والمرونة وقوة الجزء المركزي مما أدى إلى تحسين جودة الأداء الفني للاعبات في مهارة Rio & Ariana .

و كانت اهم النتائج وجود فروق ذات دلالة احصائية بين القياسين القبلي والبعدي في مستوى الاداء الفني لمهارة Ariana حيث بلغ متوسط القياس القبلي  $4.09 \pm 0.65$  ، ومتوسط القياس البعدي  $4.74 \pm 0.49$  ، ومهارة Rio بلغ متوسط القياس القبلي  $3.51 \pm 0.85$  ، ومتوسط القياس البعدي  $4.44 \pm 0.73$  .

**مصطلحات البحث:** السباحة الفنية ، الحركات، تدريب التعليق TRX

## Effect of TRX Suspension Training on Technical Performance for Artistic Swimming Figures

### Introduction

TRX (Total-Body Resistance Exercise), which as suspension training allows athletes to use their body weight (or force exerted by the gravity force) as resistance during the exercise with muscle and joint groups besides several motor plates (Janot et al. 2013).

Suspension Training body weight exercise is a unique. Its ability to improve balance, flexibility, strength, and core stability. Suspension Training into a training programs can also develop accessory muscles, assisting in total strength development. In recent years TRX Suspension

Training has gained in popularity. However, there is a lack of research on TRX Suspension Training (Dawes & Jay, 2017).

The suspension design has different forms that have in common that the ground is unstable and only the tool used is different. These exercises can lead to greater activation of motor muscle units (Dudgeon, Herron et. al, 2015; Snarr RL & Esco, 2013). Using suspension equipment is a popular choice among fitness enthusiasts. This training method is recommended for people whose goal is to achieve functional strength and health. Although suspension training is described as an innovative training method, the history of the use of these devices goes back to classic gymnastics rings (Snarr RL & Esco, 2013).

(Amalia - Marta - Milena et. al, 2016) agreed that TRX suspension training in dryland exercises has the benefit of integrating muscle strengthening and core area to ensure stability for the young athletes in Artistic swimming .

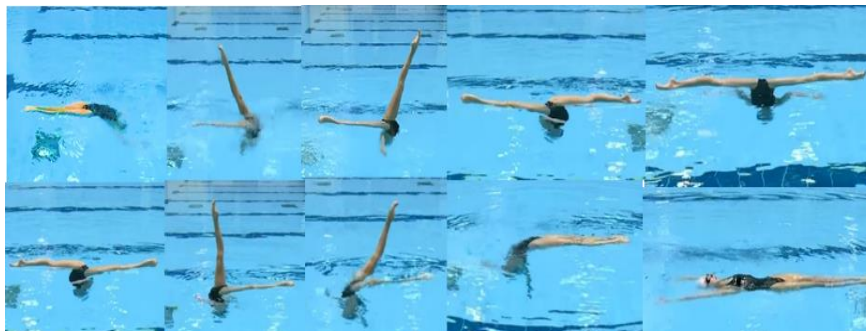
(Janot et al., 2013) found that TRX training improves muscular fitness in both youth and adult groups similar to traditional resistance training. In order to assess the real effect of a strength training program regardless of unstable and stable conditions.

Artistic swimming is a very unique among aquatic competitive sport, hard and challenging, that combined between elements of swimming, ballet, gymnastics, and dancing (Dodigovic, Sindik, 2015). Competitions are performed as solos, duets, or teams, in which the athletes perform artistic routines of elaborate movements in the water accompanied by music (Mia peric 2012).

There is also a figure competition in which the athletes perform a set of compulsory or elective elements, Figure is defined as “a combination of basic body Positions, body movements and transitions, performed in a manner” (FINA 2017). There are two compulsory figures "Ariana and Rio" for athletes between 13 to 15 years old. Figures are performed one by one by all athletes before starting the competition elective figures are announced. (LEN 2020; Ntomali et al., 2021).

They are judged regarding the accuracy of positions, transitions, control, extension, speed, height, stability, and uniformity of motion (FINA

2017).  
perfect



The

performance requires that artistic swimmers train for long hours in a variety of exercise modalities (Mountjoy, 2009). There is two types of training; land training and pool training. The training which is done on the land includes yoga, ballet, gymnastics and physical conditioning to increase physical capacity. Meanwhile, the water training contains classic swimming, basic techniques of artistic swimming, and routine set to improve the technical performance for the swimmers. This kind of training can improve the physical ability of the artistic swimmers (Dodigovic, Lucija et al., 2015).

Through researcher observation and follow up with the swimmers during the championships as an artistic swimming judge Ariana figure has been discovered in artistic swimming by deciding suggestion to use it for eight years without interruption (Peric M et al., 2012). It needs a extraordinary levels of strength, flexibility for the lower limbs during Ariana. The swimmers start the positon with back walkover is executed to a split position then sustaining the relative position of the legs, and after that point the hips rotate 180° and a front walkout is executed. Which requires an extreme range of motion and the functional strength to hold the position while upside down.

### Figure 1. Ariana DD 2.2

Moreover Rio consists of seven transitional movements. It requires extraordinary level of power, strength, stability and mobility. The most difficult part at Rio's figure "Barracuda Spin 360°", swimmers should reach to the maximum height at vertical position in which the legs emerge first from the water and Spin 360 ° their bodies (Peric M et al., 2012). So, it is quite important for artistic swimmers to develop strength, Core Muscle

Strength and flexibility. Thus, both of them are a basic for many artistic swimming movements, and some junior and senior elements (FINA 2017).



**Figure 2. Rio DD 3.1**

To my knowledge, few studies has evaluated the effects of using TRX suspension training exercises on strength, Core Muscle Strength and flexibility in artistic swimming, despite its importance and beneficial effect on physical abilities to improve the technical performance for swimmers in artistic swimming.

### **Aim of the study**

The aim of our research was to determine the effect of TRX suspension Training on Technical Performance for Artistic Swimming Figures.

### **Research Hypothesis**

The TRX suspension training has a positive effect on the technical performance for artistic swimming figures.

### **Materials and Methods**

#### **Research Methodology**

The researcher used the experimental method by using the experimental design of one group and by making the two measurements (pre-post).

## Subject

Seven Female artistic swimmers volunteered from El Zamalek Club to participate in the current study (n=7). Characteristics of the subjects are presented in Table 1.

**Table (1)**  
**Descriptive Mean ( $\pm$ SD) for subject's characteristics in Age, Weight and Height**

(N= 7)

Number	Age (years)	Height (cm)	Weight (kg)
7	14.14 $\pm$ 0.90	157.86 $\pm$ 5.81	44.14 $\pm$ 7.01

**Table (1)** shows the Descriptive data, Mean ( $\pm$ SD) for subject's characteristics in Age, Weight and Height.

## Methods of data collection

One week before starting the proposed training exercises, subjects were familiarized with the TRX exercises protocol and anthropometric characteristic, height, weight, were measured for all participants. Moreover, some physical fitness elements characteristics like Strength (upper and lower body), core muscle strength and flexibility were assessed in all participants.

## Strength

The push-ups test and squat were used to measure upper body (UB) and lower body (LB) Strength. For the push-ups test, Swimmers kept their hands shoulder width apart, while a straight line was formed from toes to hips and shoulders, the upper body was brought down and the elbows were bent about 90 degrees and again the body was lifted up. The swimmers performed the test as much as possible and the examiner counted the number of repetitions.

For the squat test, Swimmers Stand in front of the chair, facing away, feet shoulder-width apart squat down and lightly touch your backside on the chair, immediately stand back up. Repeat this until you are fatigued, Record the number of squats completed.

## **Core Muscle Strength**

The plank test was used to measure core muscle strength. Swimmers start with upper body supported off the ground by the elbows and forearms, and the legs straight with the weight taken by the toes. The hips is lifted off the floor creating a straight line from head to toe. The head should be facing towards. The test was over when the swimmers is unable to hold the back straight and hip is lowered.

## **Flexibility**

The right /Left leg split and box split were used to measure lower body (LB) flexibility. For the right /Left leg split hip bones facing forward (square hips), shoulders over hips and the arms extended behind body. Both legs and feet extended, and hold each split for 10 seconds. For the Box split legs out to sides and legs and feet extended on horizontal line. Knees facing upwards and the body upright.

## **Technical performance test**

Two days before starting the program, several tests were applied to assess technical performance from the FINA figures (under 13-15 years) compulsory group Ariana and Rio (Annex 9). Swimmers' assessment by three artistic swimming judges (Annex 4).

## **Training protocol**

The TRX Suspension Training program consisted of 3 sessions per week for a period of 8 weeks as General exercises for the upper and lower body, strength, core muscle strength and flexibility, in addition to Synchro land, and Specific water exercises in addition to routine training.

The training sessions consisted of warming up, the essential part of the training and cooling down. The duration was 20 - 50 minutes consisting of (general and Synchro land exercises). In addition 20-30 minutes (specific water exercises) by using TRX in the water, as an assistive tool to support their body and isolate the not necessary muscles to improve their skills and performance.

The duration of the program depends on the stage and the amount of training pressure and difficulty. The exercises were gradually increased every week during the weeks of the programme. (Annex 7) (Annex 8).

## TRX Training Program exercise

The TRX training program had been planned after studying research and references related to the current research and the expert's questionnaire (Annex 2) (Annex 5) about their opinion on planning TRX exercise training to progress their physical abilities and technical performance.

The programme was performed by using the TRX device related to the suspension training system. The TRX device was mounted on a rod above the ground. This allowed the participants to perform exercises directly below the connection point. In general, progress in training levels for the TRX group was as distance placed closer to the connection point, alter of two feet to one foot, and an increase in body angle to maintain intensity within the specified range.

### Training Program exercise divided into three stages;

- **First stage** was General exercises for the upper and lower body for the (1<sup>st</sup> & 2<sup>nd</sup> week).
- **Second stage** was variegated between General exercises and Synchro land specific exercises for the (3<sup>rd</sup> & 4<sup>th</sup> week).
- **Third stage** was variegated between General exercises, Synchro land exercises and Specific water exercises from (week 5<sup>th</sup> to 8<sup>th</sup>) (Annex 7).

## Statistical Analysis

Statistical analyses were performed using the SPSS version 20 in addition the improvement ratios were analysed. Paired samples T test was used for evaluating and comparing the variables between pre and post-tests, level of significant  $P < 0.05$ .

## Results

**Table (2): Mean ( $\pm$ SD), T, P value and Progress Percentage for the Research Physical Characteristics Tests**

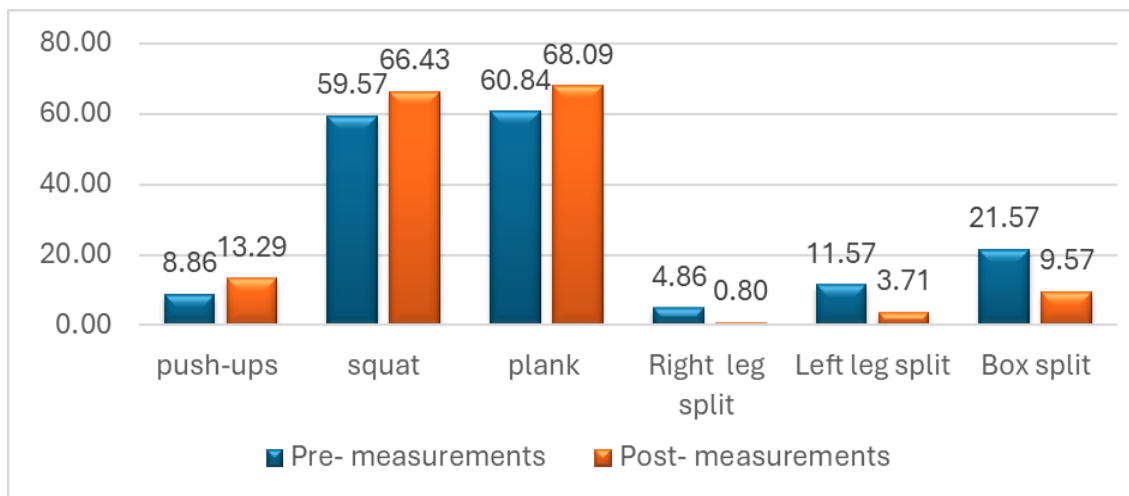
(N=7)

Variables	Measuring Unit	Pre-measurements		Post-measurements		T	P value	Progress %
		<u>X</u>	SD	<u>X</u>	SD			



push-ups	Reps.	8.86	1.57	13.29	1.60	-14.892	.000	50.00%
Squat	Sec.	59.57	5.74	66.43	5.03	-16.971	.000	11.51%
Plank	Sec.	60.84	10.17	68.09	11.82	-3.964	.007	11.92%
Right leg split	cm	4.86	5.61	0.80	1.85	2.507	0.46	83.54%
Left leg split	cm	11.57	5.44	3.71	3.86	5.228	.002	67.90%
Box split	cm	21.57	6.73	9.57	5.44	10.998	.000	55.63%

**Table (2)** shows that there is a significant difference between the Pre and Post measurements for the Research Experimental group with a progress percentages from (11.51- 83.54%).



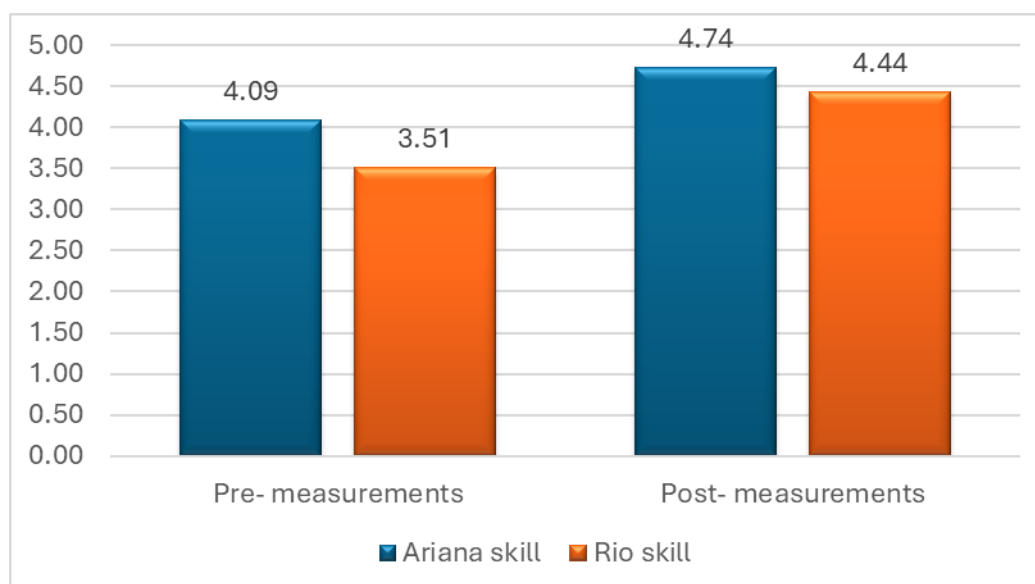
**Figure 3.** Average Pre and Post- measurements for the Research Physical Characteristics Tests

**Table (3): Mean ( $\pm$ SD), T, P value and Progress Percentage for the Ariana and Rio Skill Performance**

(N=7)

Variables	Measuring Unit	Pre-measurements		Post-measurements		T	P value	Progress %
		$\bar{X}$	SD	$\bar{X}$	SD			
Ariana	Degree	4.09	0.65	4.74	0.49	-10.119	.000	16.08%
Rio	Degree	3.51	0.85	4.44	0.73	-11.490	.000	26.42%

**Table (3)** shows that there is a significant difference between the Pre and Post measurements for the Research Experimental group for the Ariana and Rio Skill Performance with a progress percentages from (16.08 – 26.42 %).



**Figure 4.** Average Pre and Post- measurements for the Ariana and Rio Skill Performance

## Discussions

In total, seven subjects (TRX suspension Training protocol) completed the 8 week training period. As there were significant difference between the Pre and Post measurements for the swimmers. TRX training group showed increased upper-body and lower-body strength, core strength and flexibility after training. The present study was aimed to evaluate the effects of TRX suspension Training on physical abilities and technical

Performance for artistic swimming figures. There are quite a limited number of studies considering the effects of TRX on strength, core strength, flexibility and technical performance for artistic swimmers. (Tinto ,Campanella, Fasano .et al., 2013) supported the finding of the study; that TRX suspension training in dry land exercises for muscle strengthening in young athletes practicing artistic swimming, and in general reiterates the importance of strengthening the core area to ensure stability and specific adaptations, improve the quality of the movement and prevent against injury.

**Data showed in table 2;** progressing percentage observed positive influence pre- and post-applied TRX training exercises as strength for upper and lower body, push ups test pre mean  $8.86 \pm 1.57$ , post mean  $13.29 \pm 1.60$ , squat test pre mean  $59.57 \pm 5.74$ , post mean  $66.43 \pm 5.03$ , core strength, plank test pre mean  $60.84 \pm 10.17$ , post mean  $68.09 \pm 11.82$ , flexibility, right leg split test pre mean  $4.86 \pm 5.61$ , post mean  $0.80 \pm 1.85$ , left leg split test pre mean  $11.57 \pm 5.44$ , post mean  $3.71 \pm 3.86$  and box split pre mean  $21.57 \pm 6.73$ , post mean  $9.57 \pm 5.44$ .

**Data showed in table 3;** succeeding percentage observed positive influence with significant differences between pre- and post-applied TRX training exercises in technical performance for two compulsory artistic swimming elements as Ariana element pre mean  $4.09 \pm 0.65$ , post mean  $4.74 \pm 0.49$  and Rio element pre mean  $3.51 \pm 0.85$ , post mean  $4.44 \pm 0.73$

**The researcher attributes these results** to the effect of the TRX exercises programme that engage multiple muscle groups simultaneously, providing a comprehensive full-body workout. This efficiency is particularly advantageous for individuals with limited time for exercise, as it allows them to target various muscle groups in a single session.

It also Require stabilizing muscles to engage throughout a full range of motion this helps in enhancing flexibility by ensuring that muscles are stretched and strengthened through their entire range, which is particularly beneficial for movements in artistic swimming that demand extensive flexibility. It also making them highly effective for developing strength and core muscles to maintain stability and control functional translates to improved performance & reducing the risk of overstretching or injury.

## Conclusion

The results showed that using the TRX suspension training in dry land and Specific water exercises have a benefits for the required muscles for strength, flexibility and core strength that are improve the quality of the technical performance. As Figures competitions are realized by performing two compulsory artistic swimming elements by all athletes and the results of the competition are determined by the total score of the routine. Ariana and Rio needs a highest technical level to be performed and this extremely needed a high level of physical abilities to getting high marks in the competition and it's depends on the accuracy of positions, transitions and control which is consider: extension, height, stability, speed, uniformity of motion and clarity. As Ariana and Rio are the basic of many artistic swimming movements, figures, and some junior and basic senior elements movements, and some junior and senior elements features.

## Recommendations:

- 1- Applying TRX suspension training to improve physical abilities and technical performance for artistic swimmers.
- 2- Study conducted on swimmers under 13 years old; more research should be carried out on other age's group.
- 3- Using TRX suspension training in stretching sessions to help reduce muscle soreness and promote recovery.
- 4- Applying TRX suspension training instead of weight training for artistic swimmers juniors.

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