

Science, Movement and Health, Vol. XVIII, ISSUE 1, 2018
January 2018, 18 (1): 52-59

Original article

EFFECTS OF FUNCTIONAL SUSPENSION TRAINING ON L-SIT CROSS IN STILL RINGS FOR EGYPTIAN ELITE MALE ARTISTIC GYMNASTS

OSAMA Ezz-Elregal El-Awady¹

Abstract

Aim. The L-sit is an isometric movement, The L-sit performance depended on variety of muscles throughout your body but targets your abs, arms -- particularly your triceps -- and hip flexors. The training with the TRX can stimulate the motor and capacity aspects such as speed, resistance, flexibility and coordination, as well as the activation of each energy system. The purpose of this study was to investigate the effect of functional suspension training on L-sit cross in still rings for Egyptian elite male artistic gymnasts.

Methods. The sample comprised random from elite gymnasts in El-Maady club. (20) gymnasts, the subjects divided into two groups. The experimental group (n= 10) participated in functional suspension training program four-times weekly. To eight weeks. The control group (n= 10) participated in the traditional program only.

Results. Significant Difference between the experimental group and control group in Leg strength, Back strength, Core strength and performance level of L-sit cross for the experimental group.

Conclusions. Finally, the findings indicated that the functional suspension training for eight weeks could an improvement in Leg strength, Back strength, Core strength and performance level of L-sit cross for the experimental group. These results have to be taken into account by Trainers in order to better understand and implicated of these concepts in training sessions and lessons.

Keywords: TRX, L-sit cross, Gymnasts.

Introduction

The Still Rings is a gymnastics device that is used for the unique competition of male gymnasts. No gymnastics apparatus requires as much strength as this, for that reason female gymnasts do not compete in the rings. Two wooden rings are suspended from cables from a point 5.75 meters high and hanging 275 centimeters above the ground. Gymnasts perform demonstration routines of balance, strength, dynamic skills, without letting the rings swing.



The L-sit is an isometric exercise, which means it strengthens your body even though you're not moving. The L-sit works a variety of muscles throughout your body but targets your abs, arms -- particularly your triceps -- and hip flexors.

The training of the force in these moments is being done with machines that work a single specific muscle group and that isolate in some way the other muscle groups; there are exercises without implements that serve to stimulate functional strength but lack variety and richness; we see that functional training with TRX tapes must have a positive effect on the activity or sport that is practiced; since it keeps the body's center of gravity always active and stimulates the muscles, both complementary and main ones, achieving movements in three dimensions due to its use in suspension.

In the current sport, each specific modality requires specific work since the technical and tactical demands are different, more so if it is a work in a different environment such as the aquatic one, for this reason we need to create or propose; by means of this type of monographic work, a guide showing exercises

¹ Faculty of Physical Education, Sadat City University, EGYPT
E-mail address: amr297@aswu.edu.eg

Received 17.10.2017 / Accepted 20.11.2017



that stimulate the functional strength and apply these to the improvement of the different techniques in the classic swimming modality.

In each practice or sport modality different elements have been created that can be used to clarify and facilitate the approach of new motor forms that are specific to each modality, in the same way it can be used for the improvement of the techniques themselves, according to (Fitness Anywhere, 2009): "They are concretely implement's that the professor uses to achieve his objective. These guarantee the security and mastery of the body in the water and that the (practitioners) adapt to certain forms of order, the result of which would mean a better execution of the movements.

For each practice then the auxiliary means are considered as very effective aids in the teaching - learning processes of the different techniques or tactics, in the course of the practice it has been concluded that for some of the students these extra implements become a pain of head only by becoming a superior external resistance or simply by its misuse. The auxiliary means have within their functions to contribute to the adaptive forms and representations of the correct and complete movements, where the organism adapts itself and adjusts to different environments (Durkin, 2009).

There are different auxiliary means that have been used in gymnastics as basic implements, these are generally responsible for facilitating the teaching-learning processes, these implements are generally used in the basic education process of the gymnastics techniques. But what to do when we need an increase in burdens, not in the teaching process but in the improvement of motor actions and technique, in addition to achieving an increase in the physical capacities of the individual or group that practices this specialty (Gaedtko & Murat, 2015).

in the same way other implements are used to stimulate, strength, flexibility, resistance and coordination, these means that allow different stimuli. the objective is to achieve a complete transfer when has achieved an adequate domain. When using these auxiliary means the body as a physical load, very important implements are made since they guarantee non-damaging ways of stimulating the increase of the corporal capacities and this as a result generates an improvement in the body; indeed this improvement is presented as a means of counteracting those pathologies that occur constantly in sedentary individuals, pathologies such as cardiovascular, osteoarticular and muscular trauma produced by bad habits and poor performance of exercises, the activities of kinetic chains with dynamic exercises are

an improvement in the body, therefore, in daily activity and a better relationship with the environment. (Shaw, 2015).

The implements used in these kinetic forms are a little more specific tool, so their use must be done carefully and always accompanied by a specialist, in order to avoid that in the wide joint movements there are failures and injuries occur in the joints or in the muscular systems, and the implements are the culprits of these failures, not the users as in general happens.

The TRX with its modality of training in suspension, has been constituted as an implement very popular in its use but unknown in the theoretical means, this is an exercise implement made of material similar to the parachute belt, the material constitutes a difficult implement to break, this tool uses ropes joined by industrial seams, also has ring joints and systems that allow each session of this harness to graduate. (Butler, 2012)

The training with the TRX can stimulate the motor and capacity aspects such as speed, resistance, flexibility and coordination, as well as the activation of each energy system; we must take into account the application of the loads in each one of the stages according to the specificity of the sport practice, together with the functional gains our body suffers structural gains, for the classic swimming and the correct corporal hydrodynamic development, we must observe that the absolute muscular hypertrophy is not beneficial because it limits the ranges of joint movement, and prevents proper execution of the fluid and coordinated movements that occur in each style of swimming, knowing the correct use of TRX and the exercises that are possible with this Implement you can improve the actions performed with the arms and legs in all the coordinative aspects of strength and others.

Taking the materials a group of American sailors were dedicated to make different ways to exercise and not lose the physical abilities obtained in the training performed on land before, happens to be in campaigns or simply in the barracks, springs or tanks, weights and multifunctional exercise machines are not available, but these group sailors (Navi Seal) needed to exercise; it is there where at the head of the group; Randy Hetrick founder of Fitness Any Where and his companions realize the first experimental design of the TRX tapes; (Fitness, 2009).

With the inclusion of free handles as in the tera ban, the main implement of the monograph provides a variety of shapes and grips that allow total amplitude of the limbs, both upper and lower achieving the interaction of different muscles, in dynamic forms such as shapes static that can be included in the



practices; This type of training is known as suspension training (Viti, 2012).

Suspension training has two essential components in its action; the first is in the simple forms of static positions, which are known why no movement of the joints occurs, nor actions of levers; instead we know that in these forms the muscle expresses certain tensions, while the other way of exercising allows a variety of movements without maximum increases in loads

But if variants of positions of the joints and postures (Cruz Cerón, 1995).

On the other hand, there is a way of working where multiplicity of movements is expressed. This type of work consists of carrying out dynamic movement chains, where two different types of contraction are presented; concentric and eccentric the first known because the muscle is shortened and in the second the muscle lengthens, the objective of the dynamic movements is to seek the realization of movements of body sections either individual or group (Barroso, 2014).

In suspension training the point of contact of one part of the body is supported on the ground and the other part keeps suspended on the implement, we find two sections or body planes at this time; these are the transverse planes whose division is presented in the upper plane and the lower plane, divided only by the middle segment, this section is in constant pressure, which is why the suspension training always performs a direct stimulus on the middle segment of the body (abdomen-lumbar torso), contributes to the increase of the force necessary for the abdomen to maintain the curvatures of the spine; These forces present in the middle segment of the body are called compensatory forces or neutral, the neutral then is responsible for good postural alignment, which allows or affects a transmission of more efficient forces through the body. "For the selection of exercises, with the aim of protecting the spine, we must consider three fundamental muscle areas: the abdominal, the lumbar and the cervical dorsum" (Vasconcelos, 2005, p.73).

By using your own body weight these exercises are transformed into functional exercises, which intervene in the movement of several joints and a greater number of muscle groups, with the improvement that can be used at any time and place; by the anchors and the means of graduation, the TRX is an implement that guarantees a wide variety of movements of total body training, without isolating muscle groups or sections of the body, as predecessors of this form of exercise found the Roman legions who practiced exercises with their own body, with the perfection of gymnastic exercises, it was the Chinese

who increased the implementation of suspension systems starting with gripping exercises to bars, rings and different implements still current in the specific modality of gymnastics (Fitness, 2009).

There are benefits stimulated by the use of the TRX as the contribution that gives us support and mobility which is directed towards the stimulation of abilities such as strength, endurance, balance, power, cardiovascular benefits and stability of the lumbar area such as the dorsal; to this stability that occurs in these two areas we will call it neutral, all this without counting the usual instruments of gyms.

The exercises in suspension require the constant use of considerable forces of the middle portion of the body (the lumbar and abdominal area), in addition to this it must be taken into account that the most determining factor in the ages of childhood, youth is that in these stages the organism is in phases of growth where all this happens due to structural fragilities that must be rigorously respected, this is why it becomes complicated, and in turn restrictive in people with vertebrates difficulties, its use being possible, but restricting sudden movements and of prone or supine forms, as a result only the anterior, posterior planes of the body could be worked, always with bipedal postures that do not require superior efforts; Likewise, the lower and upper planes could be stimulated but working horizontally, always on foot (Snarr & Esco, 2013).

To achieve the progression, this can be done but in terms of the parameters of time increases, therefore the progression in resistance is manifested to a greater degree. The training in suspension works with the forces of attraction of the planet, we handle the concept in this moment of the environment as an external force, if to this force of attraction we add the corporal weight we would have a sum of forces, this sum is considered as the total load to overcome, both if you perform exercises in vertical suspension face up and stop hand should understand that gravitational forces attract the body with its center of gravity, this produces constant movements; To stabilize these body movements, neuromuscular responses are generated, which translate into functional, mechanical and neuromuscular gains, integrating the nervous system as the main factor (Rosania, 2014).

The techniques of the exercises and the methodology of the suspension training are designed to intentionally displace the center of gravity, the neutral or the middle portion of the body, that is to say the back and lumbar area, which activates all the central musculature during each exercise, whether active work is being done on other muscles or muscle groups; like chest press, rowing (back) or scissors



(legs) the middle session works to stabilize and balance the body in a functional way. With the performance of dynamic and functional exercises you can focus your use for any objective either to improve the physical condition to a simple practice of joint movements (Worldwide Survey of Fitness Trends for 2017). The TRX then with its form of exercise in suspension provides freedom of movement in the planes in three dimensions (up-down, forward-back and left-right), always using the center of gravity, as an integrating point of the body segments that in they actually carry out the work, as well as providing security and comfort for the realization of this type of unconventional but innovative movements. (Butler, 2012).

The purpose of the present investigation was to describe the effects of functional suspension training on L-sit cross in still rings for Egyptian elite male artistic gymnasts

Methods

The sample comprised random from elite gymnasts in El-Maady club. (20) gymnasts, the subjects divided into two groups. The experimental group (n= 10) participated in functional suspension training program four- times weekly. To eight weeks. The control group (n= 10) participated in the traditional program only.

Functional Suspension Training Protocols:

To properly name the possible body movements is from the branch of anatomy where the possibility of dividing the body into several parts is created and it is usually done from the seen as body segments.

As simple as considering the human body formed by mobile segments joined, for the purpose of analyzing and describing the movement the body is divided into large blocks or functional segments, according to (Peña, s.f.).

- HEAD; cervical area, (neck).
- TRUNK (vertebral, thoracic and lumbar zone - pelvis and sacrum.
- SUPERIOR MEMBER; scapular waist, arm, forearm, hand.
- BOTTOM MEMBER; thigh, leg, calf, foot.

These parts have in their macro structure, from one to several joints, facilitating in turn greater possibility of movement, to describe the most used concepts when naming possible movements and changes of the body segments the best option is to know the movement planes and rotation axes.

There are three body movement planes that are used to describe and locate different parts of the body. These planes are known and named as:

- Movement Plans

According to (Durkin, 2009) "the anatomical planes are imaginary cuts that are practiced to the body or to a part of it; These are perpendicular to each other and their objective is to allow the location of the different body components.

Sagittal plane

It is the antero-posterior plane that passes through the middle or median line of the body and that divides the body into two parts; Left and right, that is to say lateral, it is called the sagittal plane because it is traced in the same way as the suture that bears the same name remains, it is called a suture to a type of joints where the bones remain joined by a type of fibrous tissue; the imaginary line drawn is made by the suture present in the skull and is a defined joint. The possible movements in this plane are; flexion and extension as you bend the trunk back and forth.

Coronal plane

Like the previous plane, its name must not be a suture but a fontanelle located in the head present in the first days of the child is called the coronal fontanelle, which goes from the right side to the left side, it divides the body in two parts the front part or threshold and the back part dorsal. In this plane then the present movements could be elevations-descents frontal-dorsal of the members so much the superior as the inferior, inclinations-declinations of the trunk and multiple forms that at the end we will see with exactitude.

Transverse plane

It is the horizontal plane, which divides the body into two sessions, the upper part and the lower part. Where the push-ups and the extensions of the members can be presented.

Degrees of Freedom of Joints

The change of position in a plane can also be described as the only degree of freedom (mobility), the application that has these degrees of freedom is to identify and describe the type of movement of the joints and the amount of mobility of the structures of the anatomical joints the degrees of freedom have to do then with identifying the movements in the planes; In general, the degrees of mobility or freedom are classified as follows:

Types of Movement According to The Path

For sports specialization is necessary the correct realization of the gestures, these often fail in simple bodily functions such as push-ups at the right times, or rotations, in the same way it harms the technique of swimming until the unsuitable abduction



of the fingers of hand. To facilitate the study of these particularities of the movement, as for the detailed description of the changes of position of the body and its segments, the creation of a system called frame of reference will be achieved. This will be useful to specify the position of the body or one of its segments. as to describe the changes that occur in their position (Butler, 2012). The change of position of the body can be classified according to the trajectory that the movements describe in:

- Translation

It consists of the movement of the body from one place to another; in the forms that it contains there are the translations that follow the linear order, rectilinear trajectory on the other hand is the curvilinear trajectory in this type of movements, each of the points of the body moves in block as a whole, there are independent movements of members and of joints separated but they all follow the same pattern of displacement. Therefore, in a curvilinear translation, the body as a block describes a curvilinear movement (J. L., Mate, et al. 2012).

- Rotary or angular movements

In this type of movement, the body rotates or rotates using fixed points, each part of the body describes the same angle at the same time.

These movements have to do with the joints; these are fixed points on which the aforementioned position changes take place.

Mixed movements

In most of the habitual movements the body or some of its segments change their position while making translations and rotations at the same time. These individual movements of the joints produce a change in the center of gravity and therefore the general movement.

To take into account most of the body movements are due to the sum of angular movements, the movement of translation for example; the body experiences an advance in the straight line as a result of the individual angular movements. (Butler, 2012).

Types of Movements of The Bodies According to The Reference Systems

To identify this type of movement, it is from the physics that the first systems are created, with the detailed analysis of human movement, which requires a detailed description of the changes in the position of the body or its segments as the identification of the causes they produce it (kinematics).

To study the movement, first must analyze particular or general movements of one or several parts of the body in its environment; this environment could be specific or fixed predetermined a place where the body is moving. The reference system will then be the place where this body performs the actions, so the position of the body or a segment can be specified, the reference system can be fixed or in motion.

To structure the work of the use and handling of TRX tapes in the improvement process

of the functional force will contemplate the periods where the physical characteristics and the capacities allow it, therefore each stage is characterized in order to understand the right moment to include the use of these forms without harming some latent period of development of a certain capacity.

It should be clarified that the use of this implement should not be done in the early adult stage, after this stage the postural adjustments involve the use of the lumbar part, this complicates the vertebrae, that is why we do not recommend the use of this for intermediate adulthood (Papalia, 2005; Hahn, 1988).

There are variations of a different order to the chronological one in which individual changes are included that make the physical development possess its own rhythm of independent and heterogeneous development. This inhomogeneous rhythm is called heterochronic development, in this case it is presented that there are periods of slow development and others of intense development, according to (J. L., Mate, et al. 2012) considers that the causes of maturation Sexuality with a heterochronic character does not depend on climatic or racial factors, but rather on the nature of food and other socioeconomic factors ".

The principle of mass action - specific action

As in the characteristics of motor domain this principle states that the child in their movements begins using all the long and large muscles and then make voluntary use of their smaller muscles, saying that the child starts with large and clumsy movements, until reaching to make small and fine movements. (Papalia, 2005).

Statistical analyses

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

Results.

Table 1. the age and Anthropometric characteristics for the groups (Mean \pm SD)

Group	N	Age [years]	Weight [kg]	Height [cm]
Experimental	10	14.17 \pm 0.7	47 \pm 4.02	147 \pm 5.77
Control	10	14.09 \pm 0.8	49 \pm 4.12	145 \pm 5.85

Table 1 shows the age and anthropometric characteristics of the sample. No significant differences observed in the age and anthropometric characteristics for the sample in the two groups.

Table 2. Mean \pm SD and "T" Test between the pre and posttests for experimental group in physical variables and performance level of L-sit cross in still rings.

Variables	Experimental group		Rate %	Sign.
	Before	After		
Leg strength (kg.)	70.55 \pm 1.42	77.79 \pm 1.46	10.26	S
Back strength (kg.)	63.48 \pm 1.14	70.99 \pm 1.12	11.84	S
Core strength (time)	32.65 \pm 0.45	37.25 \pm 0.23	14.09	S
performance level of L-sit cross (degree)	6.24 \pm 0.05	6.97 \pm 0.02	11.70	S

Table 2 shows that:

- Significant Difference between the pre and posttests in Leg strength, Back strength, Core strength and performance level of L-sit cross for the posttest.
- Improvement rate between the pre and posttests were from 10.26% to 14.09%.

Table 3. Mean \pm SD and "T" Test between the pre and posttests for control group in physical variables and performance level of L-sit cross in still rings.

Variables	Control group		Rate %	Sign.
	Before	After		
Leg strength (kg.)	69.89 \pm 1.12	71.73 \pm 1.75	2.63	NS
Back strength (kg.)	64.87 \pm 1.11	66.90 \pm 1.11	3.13	NS
Core strength (degree)	31.73 \pm 0.79	32.18 \pm 0.86	1.42	NS
performance level of L-sit cross (degree)	6.28 \pm 0.04	6.39 \pm 0.02	1.75	S

Table 3 shows that:

- No Significant Difference between the pre and posttests in Leg strength, Back strength and Core strength.
- Significant Difference between the pre and posttests in performance level of L-sit cross for the posttest.
- Improvement rate between the pre and posttests were from 1.42% to 3.13%.

Table 4. Mean \pm SD and "T" Test between the two Groups (experimental and control) in physical variables and performance level of L-sit cross in still rings.

Variables	Experimental group	Control group	Sign.
	After	After	
Leg strength (kg.)	77.79 \pm 1.46	71.73 \pm 1.75	S
Back strength (kg.)	70.99 \pm 1.12	66.90 \pm 1.11	S
Core strength (degree)	37.25 \pm 0.23	32.18 \pm 0.86	S
performance level of L-sit cross (degree)	6.97 \pm 0.02	6.39 \pm 0.02	S

Table 4 shows that:

- Significant Difference between the experimental group and control group in Leg strength, Back strength, Core strength and performance level of L-sit cross for the experimental group.

Discussion

The data revealed that functional suspension training affected on all physical variables and L-sit cross in still rings.

It refers to a material that allows training in suspension with one's own body weight. It is an ideal

method where we do not need material and hardly need much space to carry out our training.

The TRX also allows functional training involving large muscle chains, therefore, a global training, motivating, different and with a large number of variants.



According to analyzing the study which published in year 2017 we observed data that help us contextualize the growing use of TRX within the active population. one of the places where most physical activity is practiced is in the environment itself, or privately (Worldwide Survey of Fitness Trends for 2017). This is at home, parks, adapted public spaces.

The advantages and facilities that we will see later in the training and suspension, with the corresponding TRX material, undoubtedly satisfy the upward trend of this type of physical exercise.

The study constant with study (Snarr, Esco, 2013) which showed that carrying out push-ups in suspension (using TRX) caused a greater activation of the pectoralis major, the anterior deltoid and the triceps brachia compared to the traditional push-ups. Therefore, suspension bends can be considered an advanced variant of traditional push-ups when a greater challenge is necessary. Although, as the study by (Borreani et al., 2015) Not all unstable devices increase muscle activation compared to traditional push-ups. Another exercise that can be done during a workout with TRX are the plates.

In another investigation, the same authors (Snarr, Esco, 2013) found that plate exercises performed with instability devices, such as TRX, caused a greater increase in electromyographic (EMG) activity in the superficial muscles compared to exercises of traditional plates that are carried out in stable situations.

Other exercises that can be carried out during a session are, for example, work in circuits, squats or those that involve work in the core zone (TRX Push-Pull Challenge, 2016).

The study by (Maté-Muñoz et al., 2015) aimed to investigate cardiorespiratory variables by comparing a traditional strength training program in stable conditions with another force program in unstable conditions (in which they place the following materials: Bosu and TRX). All this through the prescription of the training load from a scale of subjective perception of effort.

The TRX is one of the main devices that enables the application of training from a functional point of view, by the muscular activation that it requires according to later sections.

The acronym of TRX stands for Total-body Resistance Exercise, which means that it is a device that uses one's own body weight as resistance for different purposes. With a single accessory attached to a support we can train both our cardiovascular system and our muscular system, with a high proprioceptive component. In addition, there are many batteries of

exercises that will allow us to individualize the objective of our training according to our physical condition, sports...

Another benefit of the TRX that frames it in a functional training is the variety in the ranges of movement that occur. With the simple gesture of changing the degree of inclination or the orientation of the exercise, we will be activating synergistic muscles that would hardly have a leading role in a guided force machine. It also offers the possibility of individualizing the intensity of the movement according to two modifications Height or degree of inclination of the body Support points on the ground (Rosania, 2014).

Although the benefits ratified by the scientific community will be explained later, it has been shown that suspension training with TRX is able to improve the strength of 1 repetition maximum (RM) in untrained subjects as well as the improvement in jumping ability in certain sports disciplines. This fact extrapolates the functionality that gives the TRX to the athlete who uses it, improving neuromuscular aspects that will undoubtedly positively influence the development of rings skills.

Conclusions

The findings indicated that the functional suspension training for eight weeks could an improvement in Leg strength, Back strength, Core strength and performance level of L-sit cross for the experimental group. These results have to be taken into account by Trainers in order to better understand and implicated of these concepts in training sessions and lessons

Aknowledgements

Thanks to everyone who helped me to realize this material, which I have provided bibliographic materials.

References

- Barroso M, 2014, The Suspense Is Over: Study Shows Trx Builds Like Weights. *Men's Fitness*, 30(10), 17.
- Borreani S, Calatayud J, Colado JC, Moya-Nájera D, Triplett NT, Martin F, 2015, Muscle activation during push-ups performed under stable and unstable conditions. *Journal of Exercise Science & Fitness*, 13(2), 94-98.
- Butler C, 2012, TRX RIP TRAINER. *American Fitness*, 30(5), 50-52.
- Convis C, 2009, Multi-Planar Training With TRX. *American Fitness*, 27(2), 46-48.
- Cruz Cerón J, 1995, Estudio sobre las relaciones observadas entre algunos Índices



- Antropométricos, Motores y Psicofuncionales de futbolistas en edades de 12-18 años. Cali: Universidad del Valle, 60 pp.
- Durkin T, 2009, "Challenging, Functional and Fun" Product Review: The TRX Suspension Trainer. *Training & Conditioning*, 19(7), 47.
- Fitness Anywhere, Inc., 2009, TRX Suspension Trainer: manual de inicio rápido. San Francisco, California, 16 pp.
- Gaedtke A, Murat T, 2015, TRX Suspension Training: A New Functional Training Approach for Older Adults – Development, Training Control and Feasibility. *International Journal of Exercise Science*, 8(3), 224-233.
- Hahn E, 1988, Entrenamiento con niños. Barcelona, ediciones Martínez Roca S.A., 165 pp.
- Mate JL, Monroy JA, Jodra PJ, Castaño G, 2014, Effects of Instability versus Traditional Resistance Training on Strength, Power and Velocity in Untrained Men. *Journal of Sports Science and Medicine*, 13, 460- 468.
- Maté-Muñoz JL, Monroy Antón AJ, Jodra Jiménez P, Garnacho-Castaño MV, 2014, Effects of Instability versus Traditional Resistance Training on Strength, Power and Velocity in Untrained Men. *Journal of Sports Science & Medicine*, 13(3), 460-468.
- Milsom J, 2012, Hamstring injury prevention and rehabilitation training using the TRX Suspension Trainer. *Training & Conditioning*, 22(3), 55.
- Papalia D, 2005, Desarrollo humano. México, McGraw-Hill Book Company, 785pp.
- Papalia DE; Olds, Sally Wendkos y Feldman, Ruth Duskin (2001). Desarrollo humano. Colombia: McGraw-Hill Interamericana, 3 Vol., 233 p.p.
- Rosania JR, 2014, TRX Suspension Training. *Swimming World*, 55(2), 41.
- Shaw J, 2015, Trx For Swimmers. *Triathlete*, (379), 50-51.
- Snarr RL, Esco MR, 2013, Electromyographic Comparison of Traditional and Suspension Push-Ups. *Journal of Human Kinetics*, 3975-83.
- TRX Push-Pull Challenge, 2016, *Muscle & Fitness*, 77(3), 68.
- TRX SKI WORKOUT, 2014, *Ultra-Fit Magazine*, 24(2), 18-19.
- Viti L, 2012, TRX in a Group Exercise Format. *American Fitness*, 30(6), 18-19.
- Worldwide Survey of Fitness Trends for 2017: ACSM's Health & Fitness Journal. Retrieved November 2, 2017, from http://journals.lww.com/acsm-healthfitness/Fulltext/2016/11000/worldwide_survey_of_fitness_trends_for_2017.6.aspx