

## **Impact of the Swimming Practice on the Postural Balance among Tunisian Athletes**

**Sioud, Rim**

Research Unit (UR17JS01)"Sport Performance, Health & Society",  
Higher Institute of Sport and Physical Education of Ksar-saïd,  
University of Manouba, TUNISIA, and Higher Institute of Sport and  
Physical Education of Ksar Said, University of Manouba, Tunisia

**Amara, Sofiene**

Research Unit (UR17JS01)"Sport Performance, Health & Society",  
Higher Institute of Sport and Physical Education of Ksar-saïd,  
University of Manouba, TUNISIA, and Higher Institute of Sport and  
Physical Education of Ksar Said, University of Manouba, Tunisia

**Gaied-Chortane, Sabri**

Research Unit (UR17JS01)"Sport Performance, Health & Society",  
Higher Institute of Sport and Physical Education of Ksar-saïd,  
University of Manouba, TUNISIA, and Higher Institute of Sport and  
Physical Education of Ksar Said, University of Manouba, Tunisia

**Khalifa, Riadh**

Research Unit (UR17JS01)"Sport Performance, Health & Society",  
Higher Institute of Sport and Physical Education of Ksar-saïd,  
University of Manouba, TUNISIA, and Higher Institute of Sport and  
Physical Education of Ksar Said, University of Manouba, Tunisia

### **ABSTRACT**

**Our Study aims were to test the impact of swimming practice on the development of postural stability among Tunisian Athletes. The analyses deal with the impact of the practice of swimming on the postural balance. They clarify the various constraints that influence the control mechanisms involved in maintaining the balance in the resort standing. Our study addresses 20 same age category male subjects (senior) returned in: an experimental group (10 swimmers, belonging to the Tunisian national team) and a control (no sports group 10). For this study we used the Neurocom version 8.0.2 system: scale Master® consisting of a flat form of force connected to a string of data to measure the speed of oscillation of the center of pressure in strong support bipedal, eyes open on ground. The results obtained showed no direct effect of the swimming practice on postural stability of Tunisian athletes. In fact, swimming poses the need to evolve in an environment different from that in which any subject has built his balance, his motor skills of every day, the latter two are insured through the muscles; so, balance follows the permanent**

## **integration of information transmitted by three receiving systems: Visual, proprioceptive and vestibular.**

**Keywords:** Kinetic Balance, Postural Stability, Swimming, Athletes

### **INTRODUCTION**

What is typically meant by postural control consists of two functions: a function anti-gravity, to resist gravity and maintain the balance of the body, in the mechanical sense, and a function of interaction with the environment to adjust the position and orientation of the body based on the constraints it imposes [1].

It is by the movement that man builds, organizes consistently compared to the surrounding world. We relate with the space according to two separate systems, one which concerns the space of the body and one that concerns the body extra space.

Thus, the peculiarities of the aquatic environment change in sources of information specific to the driving organization of the field challenging these usual benchmarks.

The balance of a subject is indeed defined by the maintenance of the center of pressure (CP) inside his base of support. Under dynamic conditions, the position of the center of pressure depends on both the position and the acceleration of the center of mass [2].

Inadequate postural control can have a significant impact on the integrity of the passive structures: cartilaginous joint, muscular and tedious [3].

In fact, to achieve and maintain high level performance in sports, tolerance to the mechanical stress of its structures, turns out crucial and decisive and it differs in front of each external load which also depends on the genetic factors (quality of the fabrics) and functional stability interested joint and postural strategies that the athlete uses to manage its support.

So is the practice of swimming one of the extrinsic factors affecting postural balance?

The posture of an individual is the arrangement of the different body segments each other at some point [4]. It is a particular attitude of the body which is the result of an ongoing muscle activity. So, sport improves postural balance, which improvement has a close relationship with the type of activity such as swimming, which presents a working alternative and simultaneous member causing synchronization between the action of muscles agonists and antagonists providing a better balance. The purpose of our study is to determine the impact of study of the practice of swimming on the postural balance.

### **MATERIALS AND METHOD**

The analysis tool is version 8.0.2 Neurocom system: scale Master®.

This device Neurocom® type scale Master® consists of a platform of power related to a microcomputer with sensors

Rectangular in shape (45 cm / 150 cm), it is used to detect and measure the reaction forces on the ground vertically perform the subject's feet in the three axes. Thanks to software in direct

connection with the flat form of force; the data obtained are expressed in terms of speed of the oscillation of the center of pressure (VO): more this speed is low, more the subject is stable. The results are expressed in degrees per second (deg/sec)

### Micro-Ordinateur

It collects and analyzes information with pre installed by the company Neurocom® software and allows you to store them on an electronic medium (CD, floppy, USB key) (figure 1).



**Fig.1. Data acquisition**

This study examines 20 subjects all male and same age (seniors) category:

- 10 no sports, students belonging to senior classes "Abitur" school JHA of the governorate of Tunis who play the sports that during two hours per week and who have no other sports activities.
- 10 swimmers, belonging to the Tunisian national team, who train regularly at the average of 18 hours per week (nine sessions of two hours).

The assessment is conducted on a device Neurocom® type scale Master® consisting of a flat form of force attached to a computer.

### Main Morphological Characteristics:

The anthropometric characteristic's were assessed in accordance with the recommendation of the standardized procedures of the International Society for the Advancement of Kinanthropometry (Table 1) [5]. The body mass was assessed to the nearest 0.1kg using a high precision scale while the height was assessed using a Seca stadiometer (Seca Instruments Ltd, Hamburg, Germany) to the nearest 0.1cm. The foot length was assessed by a non flexible measuring tape to the nearest 0.1cm.

### Experimental Protocol:

CTSIB modified (the Clinical Test of Sensory Interaction we Balance) [6].

The Clinical Test of the sensory Interaction on scale evaluates bipodal balance by measuring the speed of the oscillation of the center of pressure (CP) eyes open closed ground (Figure 1). The duration of the test is 10 "with 3 attempts for each, after all test the subject takes a pose of about 10".

## Statistical Analysis:

All statistical treatments were realized with the VisualStat® 2005 Version 7.0.6170.0. It is a complete Visual package of statistics. It incorporates all the descriptive statistics, parametric, methods, diagrams and statistical data not parametric it treats analyses and presents the data. The normality hypothesis was verified and the independent t-test was used to identify if there is any significant differences between the two groups. the significant level was set a priori at 0.05

## RESULTS

**Table 1. The main anthropometric characteristics are presented by mean  $\pm$  SD in the following table.**

|                | Experimental group<br>[swimmers] | Control group [non athletes]: |
|----------------|----------------------------------|-------------------------------|
| Age (years)    | 20.4 $\pm$ 0.52                  | 21.9 $\pm$ 0.72               |
| Body mass (Kg) | 75.8 $\pm$ 2.35                  | 73.8 $\pm$ 4.13               |
| Height (cm)    | 183.1 $\pm$ 5.13                 | 176.2 $\pm$ 3.12              |
| Foot Length    | 27.31 $\pm$ 0.70                 | 26.39 $\pm$ 0.46              |

Initially we are dealing with a comparison of stability between the swimmers and non athletes. In a second step the anthropometric parameters in relation to stability to know the size, mass, the length of the feet.

## Comparison of Stability between The Swimmers and Non-Athletes

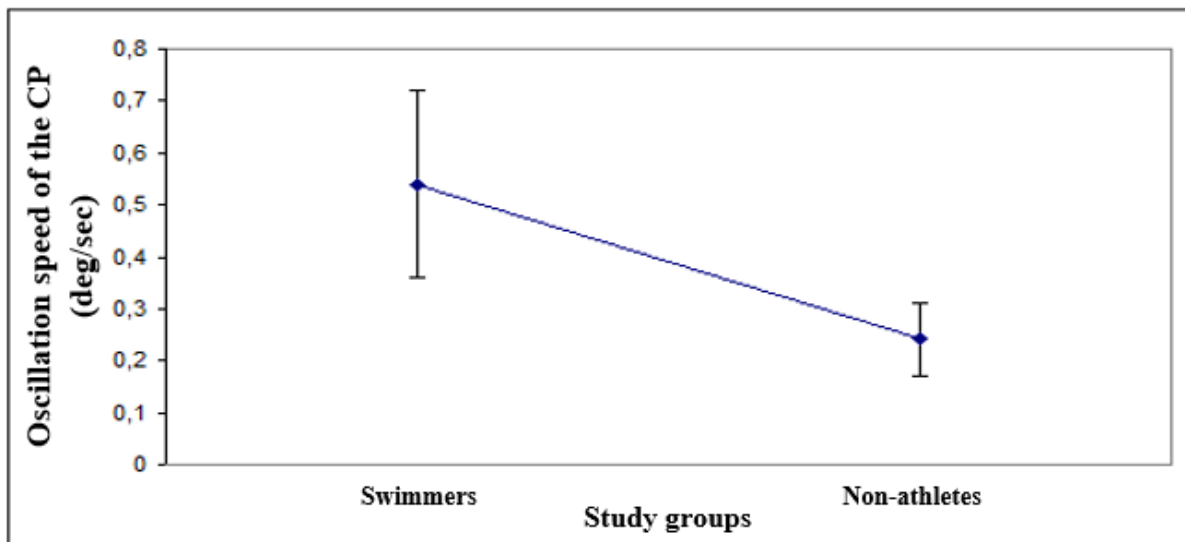


**Fig. 2: Oscillation speed of the CP (deg/sec) of swimmers and non-athletes.**

The results obtained allowed us to see than non athletes have more balance than swimmers at  $p < 0.01$ . We were very surprised by this outcome, especially since it was contrary to our initial hypothesis.

Actually, the static balance of the swimmer in the water occurs according to a position close to the vertical, the body is then subject to a double action, two forces: the weight which is proportional to the mass of the topic, vertical force of top down apply to the Center of gravity. It is constant regardless of the level of immersion of the body and buoyancy [7]. So, this last may be one of the factors that explain that non athletes are more stable than swimmers who are constantly under the action of this force. Furthermore, the behavioral changes imposed by the aquatic environment can also be another factor explaining our findings. Thus, the peculiarity of the aquatic environment changes in sources of information specific to the driving organization of the earthling questioning its usual bearings. This look our results agree with the work of Paillard [8], which highlighted the balance which is linked to the support foot control. The proprioceptive reflex of support is brought into play by the weight of the body on the lower extremities and plantar surfaces with horizontal and rigid ground contact. This reflex allows the vertical positioning of the body and members which ensures the upright attitude of automatic stability. The postural system allowing the erect, geocentric position is set by the information collected by the eye, the inner ear and the foot.

### Comparisons of the Anthropometric Parameters

This part deals a comparison of anthropometric parameters and their impact on the difference between the stability of swimmers and non athletes.

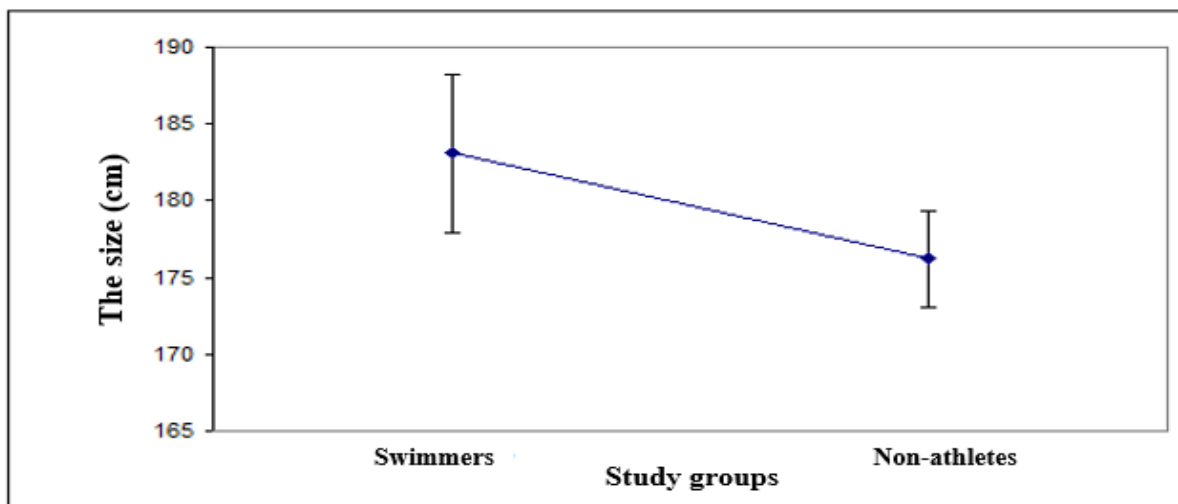


**Fig. 3. The size (in cm) comparison between swimmers and no athletes**

The results suggest a significant difference between the size of the swimmers and non-sportsmen to  $P < 0.01$  (figure 3).

Actually, the location of the center of gravity determines how the body responds to external forces. The center of gravity is low, more the subject is stable. This comparison allowed us to show that the anthropometric parameter (size) was involved in the biomechanical stability of no athletes from swimmers [1].

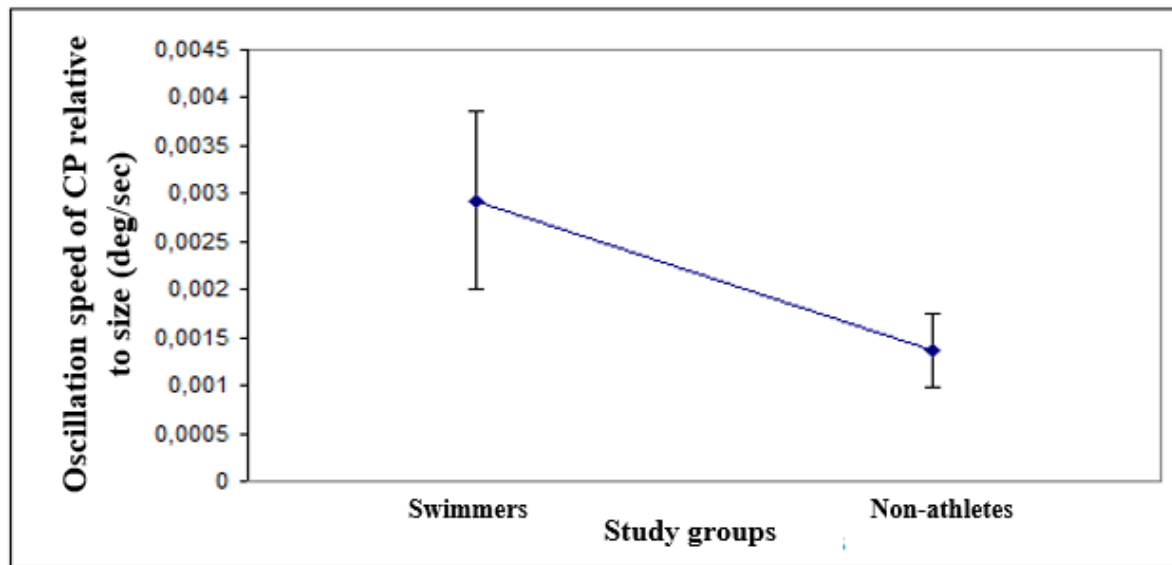


**Fig.4. Oscillation speed of CP (deg/sec) size of the swimmers and non athletes**

We relatives stability compared to the size and we analyze a comparison of size stability results remain always in the favor of non athletes who are more stable at  $p < 0.01$  (figure 4).

#### **The Length of the Foot (in cm)**

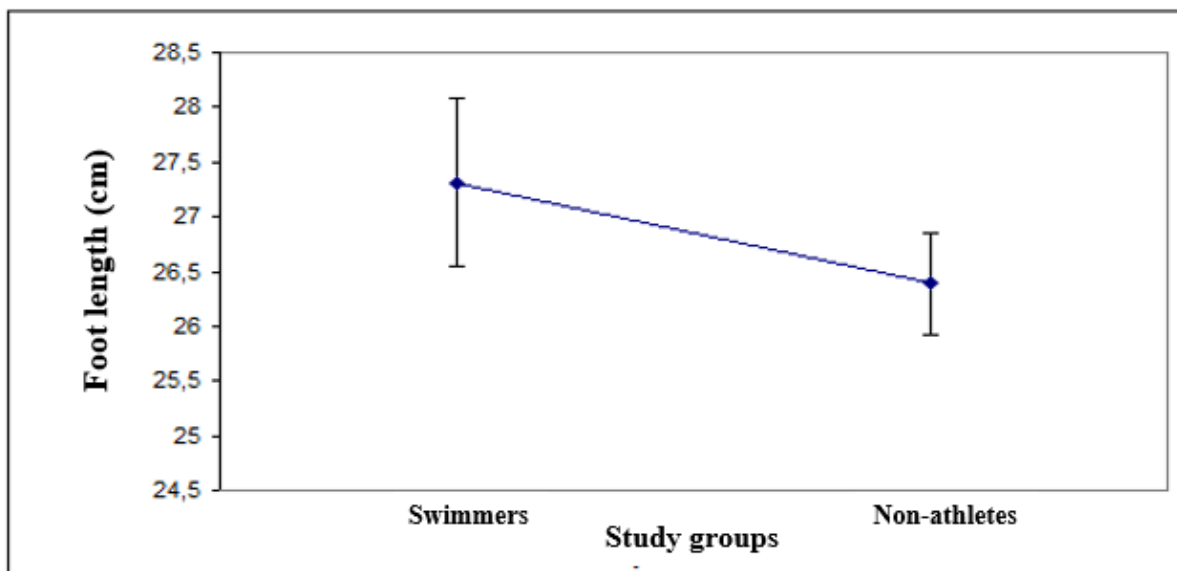


**Fig.5.Comparison of foot length (in cm) between swimmers and non-athletes**

The results obtained show a significant difference between the length of the feet of swimmers and non-athletes at  $P = 0.0023$  [figure 5]. However, the studies of Gatev et al [6] and Day et al [7] showed that the width of the ground supports also influences the nature of postural oscillations.

Finally, Corbeil et al. [9] showed that a set of motor controls controlling the return to equilibrium following a forward destabilization is limited by the temporal components related to the motor drive and also by the Anthropometry of an individual.

Our results allowed us to show that the anthropometric parameter (foot length) contributes to the biomechanical stability of swimmers compared to non-athletes.

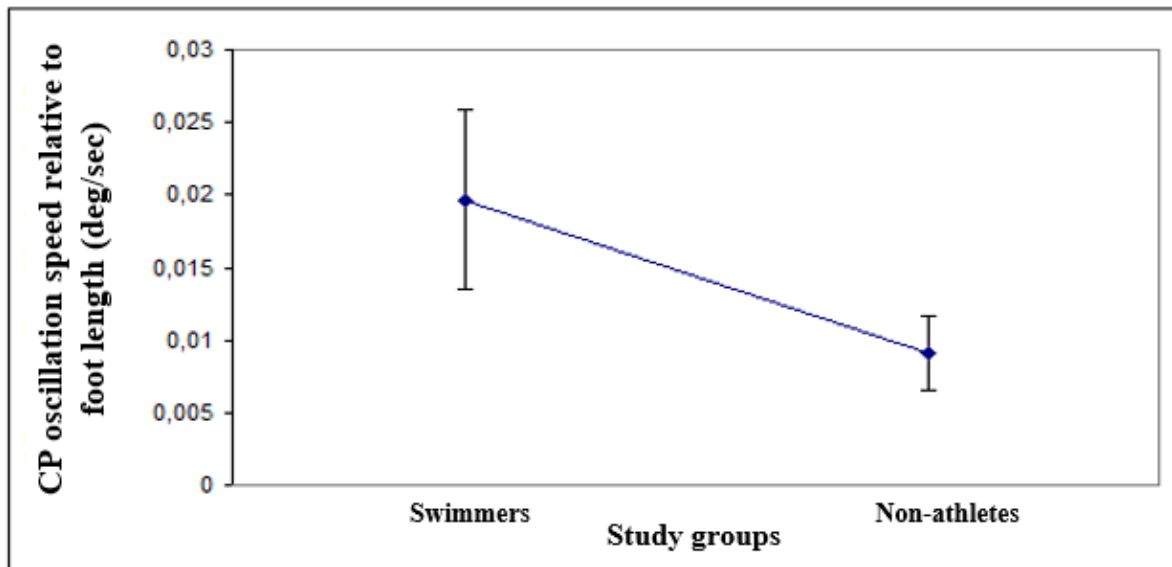


Fig.6. CP oscillation speed relative to foot length in (deg/sec) swimmers and non-athletes.

The votes obtained by relativizing the stability at the foot length show that the difference is also very significant at  $p < 0.01$  (figure 6).

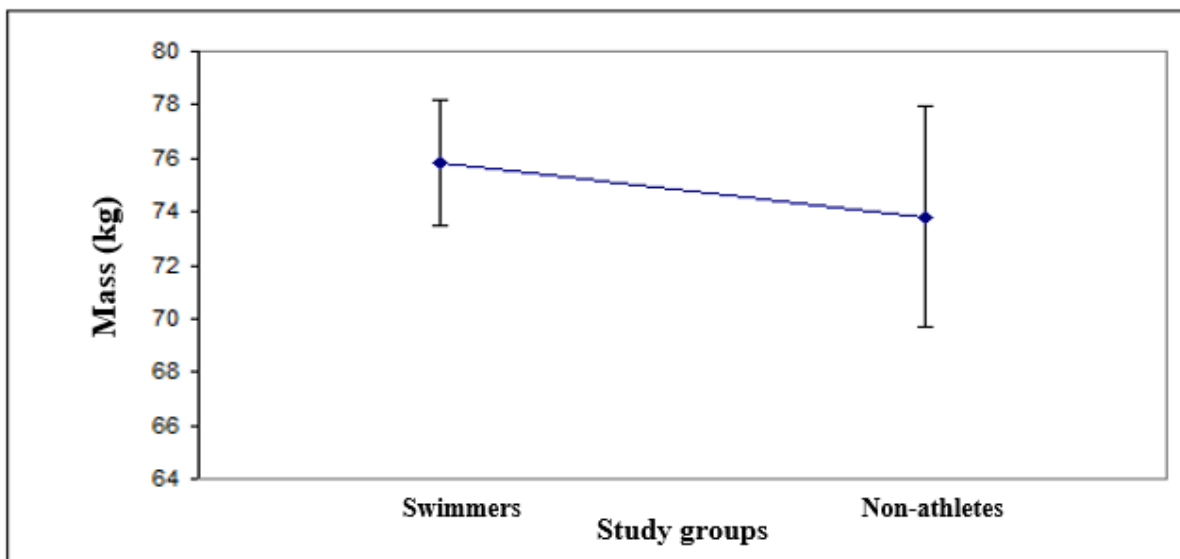


Fig.7. Comparison of mass (kg) between swimmers and non-athletes

The results showed no significant difference between the mass of swimmers and non-athletes at  $p < 0.01$ .

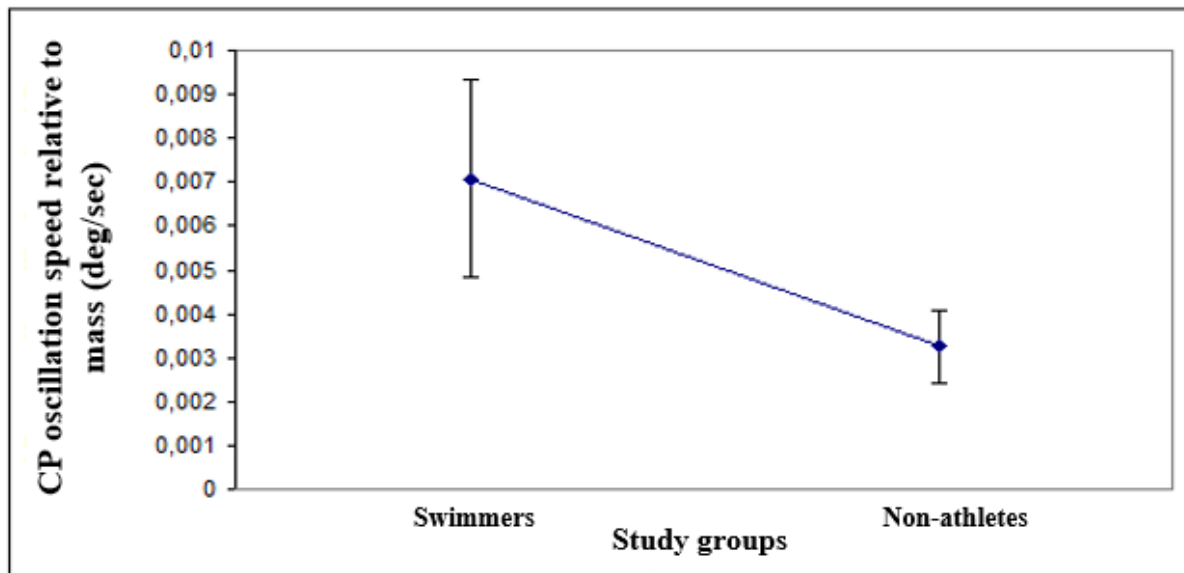


**Fig.8. CP oscillation speed relative to mass (deg/sec) of swimmers and non-athletes**

A comparison of mass stability between swimmers and non-athletes still shows a very significant difference in  $p < 0.01$  (figure 8).

## DISCUSSION

The purpose of this study was to determine whether the practice of swimming causes a change in postural balance and to know the main factors that can influence the sense of balance. In sports activities, postural control can exploit the information postural gravity and proprioceptive to encode the orientation of the body in space and thereby influence the choice of spatial repositories used to maintain the balance [10-12].

In fact, to achieve and maintain high level performance in sports, tolerance to the mechanical stress of its structures, turns out crucial and decisive and it differs in front of each external load which also depends on the genetic factors (quality of the fabrics) and functional stability interested joint and postural strategies that the athlete uses to manage its support [13-15].

Moreover, during the practice of swimming, the movements that we perform are accompanied by postural adjustments, which have the role of providing support to the realization of the action, to maintain the balance of the body despite the disturbances generated during the movement [16-19].

Despite the lack of effect of swimming practice on postural stability in our present study, swimming remains a physical activity that improves the postural equilibrium of individuals, but it requires a longer period of training for that it gives significant results [20-23].

## CONCLUSION

The results obtained showed that "non-athletes" are more stable than "swimmers". In fact, swimming poses the need to evolve in a different environment marked by the absence of gravity and in which all subjects have built their motor skills and their postural balance every day. Therefore, substitute the field repository (a body in an erected station subjected to the force of gravity, on a basis of stable and permanent support) a new repository, that of the aquatic environment (a suspended body subjected to the two forces that are the thrust of Archimedes and Gravity), is a specificity of aquatic activities that constitutes a prerequisite to their practice. It is currently well accepted that the maintenance of the "Standing Station" is a model for the study of the sensory-motor hierarchical system which has multiple sensory inputs, in fact, the visual, vestibular, proprioceptive and tactile systems are Mainly involved in this task of stabilizing the projection of the centre of gravity (CG) within the levitation polygon.

## Limit of the Study

The results of this current study are limited to a restraint number of participants. A further investigation would be preferable.

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## Disclosure Statement

No potential conflict of interest was reported by the authors.

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