

## Research Article

# Physical Exercise and the Inflammatory Effect on Skeletal Muscle Due To Interleukin-6

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**Citation:** Dorta HS (2016) Physical Exercise and the Inflammatory Effect on Skeletal Muscle Due To Interleukin-6. J Orthop Ther. JORT114. DOI: 10.29011/JORT-114.000014

**Received Date:** 21 September, 2016; **Accepted Date:** 24 October, 2016; **Published Date:** 18 February, 2017

## Abstract

Interleukin-6 (IL-6) is a cytokine acting both the innate and the adaptive immune response. Their relationship is in pro inflammatory, presenting in great evidence for the practice of physical exercise but its activities extend to other organ. Depending on the type of exercise and IL-6 increases the frequency quantity in muscle tissue and into the bloodstream. Its performance is in large muscular system and your understanding is of great importance for the treatment of conditions in other systems.

**Keywords:** Physical exercise; Skeletal muscle; Interleukin-6

## Introduction

Physical exercise is associated with numerous benefits, but its practice is a causative stress factor for muscle tissue [1]. The practice and the physiological responses found during the exercises are related to your period of practice, intensity, time and frequency [2]. All these variants of physical training is correlated with muscle response directly proportional to the type of muscle fiber [3]. During the practice of physical activity can induce an inflammatory response, by increases in serum levels of IL-1, TNF- $\alpha$  and IL-6 cytokine responsive, followed by release of anti-inflammatory cytokines such as IL-10, and IL-1ra, sTNF-R2 are inhibitors of pro-inflammatory cytokines [4]. Interleukin-6 (IL-6) is a cytokine acting both the innate and the adaptive immune response. It is synthesized by monocytes, endothelial cells, fibroblasts and other cells in response to microorganisms and also to stimulation by other cytokines, particularly interleukin-1 (IL-1) and tumor necrosis factor (TNF- $\alpha$ ) [5].

## Physical Exercise

Exercise is defined as any body movement, held with the participation of skeletal muscle involving a higher energy expenditure when compared to resting levels, being carried out through repetitive body movements, structured and planned, resulting in an improvement of one or more components of physical fitness [6].

When it comes to exercise their benefit level is huge, thanks to physical exercise have the control of body weight, modulation of blood glucose levels and reduce other metabolic factors and the development of cardiovascular disease [7]. Improved immune system [8], improvement of the cardiopulmonary system [9], the operation of increasing the renal system [10], increased levels of neuronal connections [11], increasing muscle mass [12], the release of endorphins [13], and decreased levels of body fat [14]. But there are some variables that influence the way in which the exercise is applied as frequency, mode, duration, intensity, and factors such as diet, physical conditioning that can also modify the effect of exercise [15].

## Physical Exercises Types

There are two types of exercises, acute and chronic, the responses of muscle metabolism to acute or chronic physical exercise demonstrate high level of dependence of methodological schemes used in their research. The various existing studies show wide variation in relation to the methodological approach, making comparisons problematic some possible [16]. Although the exercise be broadly classified as a stressful stimulus looks more appropriate to divide the response to exercise of two components: acute and chronic response [17].

### Acute Physical Exercise

The exercise term acute refers to the physiological responses that occur when the exercise is being developed [18]. The performance

of acute exercise has shown effects on some physiological parameters such as blood lipid concentrations, lipoproteins, cholesterol, blood pressure, glucose metabolism, immune system, and many other variables [19,20]. The acute response is transient reaction to stress while the chronic stimulation generates chronic adaptation response to exercise, which enables the body to tolerate more adequately stress [21,22].

### **Chronic Physical Exercises**

Chronic exercise term refers to the chronic adaptation response to exercise, which enables the body to tolerate more adequately subjected to stress during their practice [23,24]. The physical exercises practiced regularly or chronic lead to important physiological and morphological adaptations to maintain the homeostasis of the organism and these adjustments are important for the control of many diseases, particularly cardiovascular and endocrine-metabolic nature [25,26].

### **Physical Training Form**

It is known that physical activity is a known form of stress and chronic exposure to it, called physical training [27], is able to trigger adaptations in response to higher production of these free radicals. There are two different forms of training, training with aerobic [28] exercise and anaerobic [29].

#### **Anaerobic Exercises**

Anaerobic exercise is defined as high-intensity, short duration exercise (up to 3 minutes), energy is mainly obtained from the first system, without participation of oxygen [30,31]. The resistance or anaerobic exercises seem to prevent more sharply the loss of muscle mass, and increase glucose utilization [32].

#### **Aerobic Exercises**

Aerobic exercises are those that have long duration and the intensity of which can be low, moderate or high, keeping however the measured pace, causing improvement in oxygen transport to the cellular level, developing aerobic endurance, and is also called cyclic exercises [33,34]. The regular practice of aerobic exercise provides, both at rest and during exercise, lower heart rate and increased stroke volume. The regular practice of progressive exercises (chronic), determines the maximum cardiac output increase, slight increase in the filling pressures of the heart during exercise, but normal at home, and dilatation and hypertrophy of the heart [35,36].

### **Skeletal Muscle Fibers**

Skeletal muscles were initially classified as slow and fast, in accordance with its prevailing conditions (aerobic or anaero-

bic) [37,38]. Since the muscle fibers are classified by type I fibers (slow), type II fibers (fast) and Type IIb fibers (intermediate) [39]. Type I fibers or slow fibers, also called tonic, have reddish color due to the presence of oxygen bound to the protein myoglobin, and have a large number of mitochondria, and most of them are located near the peripheral region fiber [40]. This type of fiber is more resistant to fatigue, mainly in exercises that require longer time (aerobic), and its power source is from oxidative metabolism to generate ATP [41,42]. Type II fibers, or fast-twitch fibers, also called phasic or dynamic, have white color with a small amount of myoglobin, being replaced by enzymes in the glycolytic type [43]. Have a reduced number of mitochondria, are poorly vascularized and use glucose for their energy with minimal or no use of oxygen (anaerobic), being able to intend intensely, with great strength and power, because its long fibers allow for contraction and relaxation in a very rapid sequence with a more explosive action, being more efficient for high-speed and power peaks. But fatigue very quickly, only resisting short term exercise (anaerobic) [44,45]. The fibers of the type IIb, classified as intermediate, possess features of two other types, such as the fact that metabolize glucose and oxygen to obtain energy. We may have changes in their predominance according to the stimulus to which it is subjected during exercise [46,47].

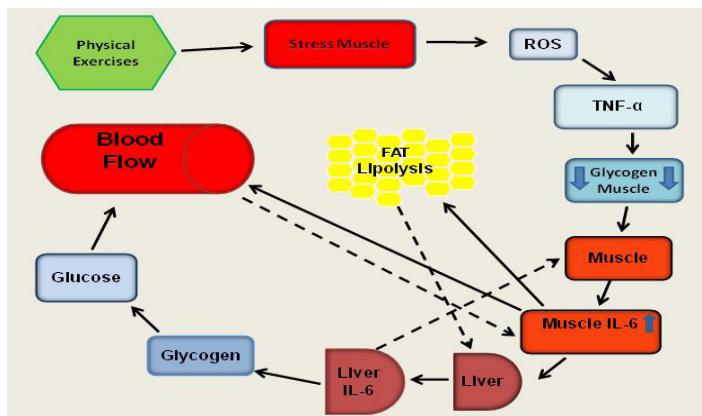
### **Interleukin-6**

Interleukin-6 (IL-6) is a cytokine acting both the innate and the adaptive immune response. It is synthesized by monocytes, endothelial cells, fibroblasts and other cells in response to micro-organisms and also to stimulation by other cytokines, particularly interleukin-1 (IL-1) and tumor necrosis factor (TNF- $\alpha$ ) [48]. The IL-6 is an important inflammatory marker. It is a cytokine involved in a number of immunological activities, in particular the synthesis of acute phase substances by the liver and is involved in the metabolic regulation of the PCR itself. Like its receptor (gp130), is widely expressed during the inflammatory reaction, producing undesirable effects on various organs [48,49]. In skeletal muscle, the elevation of pro inflammatory cytokines such as IL-6, is associated with the incidence of damage to the muscle tissue induced high-intensity activities or actions eccentric [50]. However, subsequent studies established that IL-6 may increase even in the absence of injury [50,51]. The IL-6 plasma during exercise increases with the intensity and duration of activity in IL-6 can be regarded as a "exercise factor"; this cytokine, which is produced and released in skeletal muscle in response to exercise, exerts its effects in other organs of the body [50,51]. In this sense, as adipokines term was established for cytokines and other peptides that are produced and secreted by adipocytes, the term myokines, can be used to cytokines and other peptides that are produced and released by muscle fibers [50,52].

The Cytokines can be classified according to their function, pro inflammatory or anti-inflammatory. Pro-inflammatory cytokines induce increased inflammatory process, such as for example, interleukin-1 $\beta$  (IL-1 $\beta$ ), interleukin-6 (IL-6), Interleukin-8 (IL-8), tumor necrosis factor (TNF- $\alpha$ ), interferon (IFN), interleukin-2 (IL-2) and chemokines. The anti-inflammatory cytokines are characterized by decreased inflammation by regulating inflammation by restriction pro inflammatory cytokines, among which are: interleukin-4 (IL-4), interleukin-10 (IL-10), interleukin-13 (IL-13), as well as receptor antagonist of IL-1 (IL-1ra) [52,53].

## Interleukin-6 Is The Physical Exercise

Physical exercise can be regarded as a prototype of physical stress. Many clinical physical stressors (eg surgery, trauma, burn, sepsis) induce a pattern of hormonal and immunological responses to have Similarities of exercise [54]. During the practice of physical exercise suffer functional changes in the immune system, and the response generated depends on the volume and intensity of training [55]. Physical activity can induce an inflammatory response, by increases in serum levels of IL-1, TNF- $\alpha$  and IL-6 cytokine responsive, followed by release of anti-inflammatory cytokines such as IL-10 and IL-1ra , STNF-R2 are inhibitors of pro-inflammatory cytokines. So the type, duration and intensity of exercise are major factors for the profile of response of cytokines after exercise [56,57]. In a frame where the IL-6 increases exponentially in response to exercise and reduces post exercise period (Figure 1).



**Figure 1:** Demonstrates a few steps from the exercise and the formation of IL-6 in skeletal muscle and hepatic system.

Where is occurring IL-6 plasma increases it is related to the duration of the exercise, since IL-6 mRNA is regulated by muscle contraction, so the rate of transcription of this gene is enhanced by exercise, however, some factors stimulate IL-6 release including: changes in calcium homeostasis, low levels of muscle glycogen and increases the formation of reactive oxygen species [57-59]. With the carbohydrate supplementation inhibits the increase

of IL-6 induced by exercise, because it affects the expression of mRNA for IL-6. The IL-6 synthesized in response to exercise can act locally in the muscle or may be released into circulation, being able to induce systemic effects by controlling energy metabolism [54,55,60]. This mechanism is associated with stimulation of protein kinase route activated by AMP (AMPK), which is increased by IL-6, suggesting that activation of AMPK in muscle tissue depends on IL-6, stimulates AMPK activity several mechanisms, that increase the generation of ATP, including fatty acid oxidation and glucose transport in skeletal muscle [61,62]. The exercise-induced Increase of plasma IL-6 is not linear over time; During exercise repeated measurements show an accelerating Increase of the IL-6 in plasma in an almost exponential mannered, Furthermore, the peak IL-6 level is Reached at the end of the exercise or shortly thereafter, Followed by the rapid decrease towards pre-exercise levels [54,60].

The IL-6 level in blood Has Been shown to be Significantly enhanced 30 min after the start of running, peaking at the end of 2.5 h of running. In other studies, where IL-6 has not Been measured During the running but at several team points after, maximal-IL-6 levels Have Been found immediately after the exercise Followed by the rapid decline (half-life of 1-2 h). Thus, Following the marathon run, maximal IL-6 levels (100-fold Increase) Have Been measured immediately after the 3-3.5 h race [54,60].

## Conclusion

In our review we conclude that the training status and performance on plasma IL-6 concentration changes are more inconclusive During exercise, your peak predominated is pos training and studies should be conducted to verify the skeletal muscle is an endocrine organ in response to contractions produces and releases 'myokines', Which subsequently can modulate the metabolic and immunological response to exercise in several tissues.

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