

## Effects of exercise on skin surface

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**Abstract.** Physical effort is the basic component of a healthy lifestyle. Through induced molecular changes, physical effort shapes the functional activity of many organs. The body's response to physical effort involves a series of interactions with a high degree of complexity. The oxidative stress induced by physical effort alters the redox balance in the tissue structures with an incomplete antioxidant system adapted to the new metabolic requirements. The skin can be a real target for biochemical manifestations specific to the phenomenon of oxidative stress induced by physical effort. Physical effort induces in the skin a series of local reactions that lead to a decrease in the specific immune response, or induce a change in the biocompositional field on the skin surface in both cases, the result increase in the degree of colonization with microorganisms. The axis of physical effort - oxidative stress - skin changes still remains unexplained.

**Key words:** *exercise, skin, oxidative stress, recovery.*

### Introduction

In a current context, sedentary lifestyle is one of the most important causes in the onset of many pathologies, both in the field of metabolic pathologies and psycho-emotional and social pathologies.

Community of clinicians has outlined in the last decade a scientific field of interest that is based on the concept of healthy lifestyle. However, so far this concept has not been defined, and its components, or their hierarchical importance, have not been accurately identified.

The concept of a healthy lifestyle is interpreted by the community as a set of measures aimed at maintaining the health of the community. Physical effort is the basic component of a healthy lifestyle. Through induced molecular changes, physical effort moderates the functional activity of many organs. Body's response to physical exertion involves a series of highly complex interactions between the lungs, heart, skeletal muscles, systemic and pulmonary circulation and mitochondrial respiration (1).

At the cardiovascular level, physical effort causes an increase in cardiac output and peripheral vasodilation occurs, and causes a decrease in systemic vascular resistance, events that facilitate the proper transport of oxygen to tissues and meet the body's metabolic requirements.

However, physical effort can induce the phenomenon of oxidative stress in various tissues. Oxidative stress is a phenomenon that characterizes the alteration of cellular redox balance, a phenomenon that can induce cellular apoptosis. Intense physical exertion induces the synthesis of free radicals of oxygen and nitrogen that inactivate the antioxidant system of cellular defence and thus installs the phenomenon of oxidative stress that is associated with the peroxidation of lipids in cell membranes.

Malonyl dialdehyde is a product of lipid peroxidation in the structure of biological membranes and is accepted as a biomarker of the phenomenon of oxidative stress (1). Numerous experimental clinical studies have shown the association between the phenomenon of oxidative stress and various pathologies, endothelial dysfunction, type 2 diabetes, atherosclerosis, cardiovascular and neurodegenerative diseases (2, 3, 4). On the other hand, oxidative stress has been associated with various cellular signalling pathways, responsible for the phenomenon of adaptability to physical exertion or decreased peripheral insulin resistance (5). For these reasons, the oxidative stress induced by physical exertion cannot be compared in intensity or perhaps as a molecular mechanism with the oxidative stress induced or associated with other pathologies. The oxidative stress induced by physical effort alters the redox balance in the tissue structures with an incomplete antioxidant system adapted to the new metabolic requirements.

The skin can be a real target for biochemical manifestations specific to the phenomenon of oxidative stress induced by physical effort. Recent relative experimental studies have shown that regular physical effort prevents mitochondrial dysfunction and signals proteins responsible in the aging process generically called progeroids (6). By extrapolating the results, we can say that physical exertion prevents alteration of biochemical balance of the skin and thus prevents skin deterioration (6, 7). In the last decade, a series of myokines have been identified, functional proteins synthesized by skeletal striated muscle subjected to repeated physical exertion (6, 3, 7). Myokines are driven by the circulatory system and reach the peripheral tissues, occurs in their metabolic control as factors mediated by physical exertion.

The molecular mechanism by which physical effort acts on the functional dynamics of the skin is based primarily on the action of IL-15. During physical exertion, skeletal muscle transiently synthesizes an increased level of IL-15 that can act on the physiological dynamics of the skin (7, 9).

The connection between the physical effort and the intensity of its time allocated to the phenomenon of oxidative stress and the synthesis of IL-15 at the muscular level remains unclear. IL-15 can be synthesized as a signal responsible for the peripheral adaptation of tissues to physical exertion. Based on what has been reported in the literature, it can be assumed that biochemical changes related to the phenomenon of oxidative stress induced by physical exertion at the skin level such as pH change can be an adaptive process of the skin to new physiological requirements dictated by physical exertion.

### Materials and method

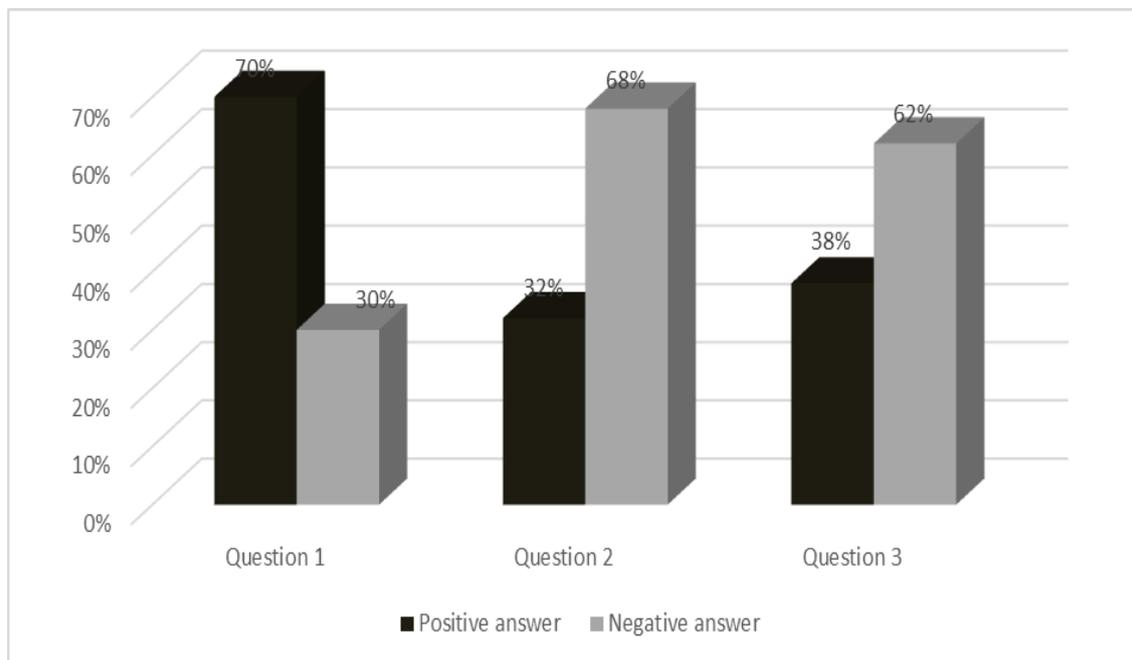
The experimental study was based on the analysis of data provided by volunteers in the form of anonymously completed questionnaires. The questionnaire consisted of 11 questions grouped on 3 profiles as follows; lifestyle, medical profile and profile applied to the research topic. The questions related to the specific profile of the topic were designed in such a way that a large number of subjects with a similar biological and psychosocial profile could be identified, so that the homogeneity of the study group was relevant, reproducible, and with biomedical applicability. In order to be aware of the importance of the answers given, the questionnaire contained identifying data such as the title and purpose of the study. A total of 65 questionnaires were analysed, the results being processed and evaluated only for the specific profile of the research topic. From the principles related to the care and control of the biochemical dynamics of the skin, we decided to study only the completed questionnaires of females aged between 18 and 23 years between may-october, 2020. The study encountered a number of limitations, which are due to the national health context, the refusal to complete the questionnaire, the low degree of correlation between control questions and the small number of subjects following an organized physical program. The study activity of the present research topic was carried out in the online environment respecting the measures provided by the national health context.

### Results and Discussions

The skin is a dynamic histological structure from a biochemical and immunological point of view. Metabolic changes induced by different physiological or pathophysiological conditions directly influence the change of specific parameters at the skin level, such as: pH, synthesis and elimination of specific or general metabolites and the formation of a biological field favourable to the colonization of microorganisms. The results of this study represent a fundamental basis for sports microbiology studies or phytotherapy associated with physical effort.

**Table 1.** Analysis of the answers completed by the volunteers for the specific profile of the study

Question	Positive answer	Negative answer
Do you know the normal pH value of the skin?	70%	30%
You have reported a change in skin pH as a result of events such as: phases of the menstrual cycle, diet, use of cosmetics with known pH?	32%	68%
Have you reported a change in skin pH due to physical exertion?	38%	62%



**Figure 1.** Analysis of the specific profile to the study topic

(Question 1- Do you know the normal pH value of the skin?; Question 2- You have reported a change in skin pH as a result of events such as: phases of the menstrual cycle, diet, use of cosmetics with known pH?; Question 3 - Have you reported a change in skin pH due to physical exertion?)

Through metabolic requirements, physical effort alters the function of the physical, chemical and biological barrier of the skin and as a result reversible changes can occur that influence sports performance or the general state of biological comfort of the individual.

Physical effort is the most useful measure in controlling body weight, mobility and metabolic balance. However, clinicians often overlook the importance of physical effort as a treatment or prophylactic measure for a number of chronic conditions in particular. Numerous clinical and non-clinical experimental studies have shown and demonstrated the importance of recommending physical exertion as a therapeutic option in the treatment of comorbidities that include; obesity, chronic obstructive pulmonary disease, diabetes, osteoporosis, osteoarthritis, cancer and joint pain (10).

Most experimental studies have focused on the implications of physical effort on the dynamics of biochemical, metabolic and skeletal muscle molecule behaviour, ignoring the general transient pathophysiological implications arising from changes in the biological behaviour of somatic or cardiac skeletal muscle. Physical effort, however, remains a basic component of a healthy lifestyle, although it can induce a series of changes in metabolic behaviour that are not yet elucidated as a biochemical mechanism, an example being the activation of insulin-independent hypoglycaemic mechanisms.

Physical exertion through the new metabolic requirements generates an increased level of metabolites to be eliminated in specific ways. As a result, the structures involved in the elimination of metabolic products, including the skin, have an increased cycle of activity. Therefore, many local reactions occur that can induce a series of functional changes to the structure involved in the elimination of metabolic products.

Physical effort induces a series of local reactions in the skin that lead to a decrease in the specific immune response or induce a change in the bio compositional field on the skin surface, in both cases the result being an increase in the degree of colonization with microorganisms. Local colonization with microorganisms can cause changes in skin pH by two possible ways, the change in pH is based on the body's reaction to bacterial colonization and the complex of bacterial metabolism changes the local skin pH. Therefore, physical exertion may favour the colonization of pathogenic bacteria or not at the skin level, and as a result colonization may cause changes in skin biology.

In short, skin is a complex and dynamic ecosystem naturally inhabited by microorganisms. Skin microbiosis is involved in regulating the physiological and immune function of the skin. The interaction between the microorganism and the host depends largely on the context, the genetic predisposition of the individual, the state of the skin barrier and the interactions between the microorganisms (11).

Therefore, physical exertion can influence the complex dialogue between the microorganisms that normally colonize the skin and the host. Metabolism changes followed by skin excretion of metabolic products are again an extremely relevant cause in terms of changing the biochemical behavioural status of the skin. During physical exertion, oxygen free radical generation sites are active, which induce a specific biochemical behaviour manifested by the installation of the oxidative stress phenomenon at the level of different histological structures (12). The phenomenon of oxidative stress can be generalized and expanded as a result of physical effort, by activating the ways of generating free oxygen radicals. Therefore, the phenomenon of oxidative stress is an important cause of biochemical changes that occur in the skin of physically active subjects. The skin has an antioxidant system of relatively medium cellular defence, and free oxygen radicals generated as a result of pressures exerted by external or internal factors are neutralized under normal conditions. However, there are conditions in which the antioxidant mechanisms of skin defence are overcome and redox disorders occur that can lead to manifestations such as cellular aging or various forms of dermatitis (13). Physical exertion-induced oxidative stress can alter the normal functional status of the skin directly or indirectly by altering the normal microbiosis which, as explained above, induces changes in skin pH. Alteration of the normal functional status of the skin influences the physical, immunological and mental evolution of the subject. The cited changes influence the biological quality of the individual. We discussed this pH being a noticeable indicator and analysed due to the implications in the field of cosmetics.

Analysing the data processed from the questionnaires we can say that in a relatively high percentage, subjects who voluntarily completed the questionnaire have minimal knowledge about skin pH and its importance. The result may be due to the lack of information on the subjects or the lack of specific and credible information in the literature that can be accessed freely. The relatively high percentage of subjects who did not notice skin changes induced by physical exertion can be explained by the relatively small number of subjects who made up the study group or failure to take into account these changes are often attributed to cosmetics or composition water.

The study is a topical approach in the field of biomedical and can be a cornerstone for many experimental studies in areas still unexploited such as sports microbiology or phytotherapy associated with physical effort. Physical exertion performed in a well-established context is an extremely beneficial therapeutic basis in medical recovery processes or as a functional set of the concept of healthy lifestyle.

## Conclusions

The model used as a questionnaire should be flexible and realistic enough to identify all the factors that independently change the skin pH as a result of processes induced by physical exertion and separate them from those due to the use of cosmetics.

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