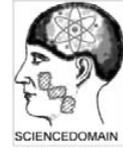




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## Psychological Benefits of Sports and Physical Activities

**Alicia Garcia-Falgueras<sup>1\*</sup>**

<sup>1</sup>Official College of Psychologist in Madrid, Spain.

### Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

### Article Information

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### ABSTRACT

Growing evidence is converging to suggest that different metabolic and cognitive functions are improved by and after physical exercise. They include prevention of certain mood impairments such as depression, strengthening of the immune system to cope with certain diseases or reducing stress subjective perception and disability causes by specific pain. In this last sense, the discomfort threshold has been demonstrated to be modified in habitual sportsmen and sportswomen, being more resistant to pain. Physical activity acts on many metabolic aspects and we will expose in this review article three of these pillars of action, with examples and scientific references. On the other hand, variables such as frequency and pace of physical exercises are important to consider for possible health profits. In this sense, seconds, minutes and repetitions of each specific exercise are of much importance for its accurate benefits and for taking into account to design a proper working out sport training routine.

\*Corresponding author: E-mail: [algarfal@hotmail.com](mailto:algarfal@hotmail.com);

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## 1. INTRODUCTION

Sports are defined as all forms of competitive physical activity, through causal or organized participation in teams, which aims to maintain or improve human physical ability and skills, usually offering entertainment to participants and cheerfulness to winners. In some cases there are spectators or public who watch the sportive competition and do not participate themselves with any physical activity. On the other hand, physical activity does not necessarily imply the competitive component in teams, because it can be done individually and it is defined as any muscular effort or movements during personal systematic training, working out through different exercises. Those exercises are equally aimed to improve individual human physical ability and skills. Therefore, physical activity is usually a series of different modalities of physical exercises, involving different parts and muscles of the body and it is an essential previous step for any sport. Moreover, sport and physical exercises are sharing many common goals.

Recent studies show that physical exercises, regardless of type, from aerobic as even walking fast to anaerobic, at least three times per week, would decrease the risk of dementia over 65 years of age by up to 32 % [1-3], reaffirming the literal meaning of "healthy mind in a healthy body".

Physical activity acts on many metabolic aspects and we will expose in this review article three of these pillars of action with examples and scientific references:

- a) Physical well-being: Sport reduces stress [4] and facilitates endorphins release [5]. Also sport improves the immune system [6,7].
- b) Emotional well-being: Sport affects psychological elements such as self confidence [8,9] and it also reduces the risk of depression [10,11].
- c) Modification of the threshold for discomfort or pain: during exercise and after that, it helps to control pain perception [12,13].

In a pilot questionnaire performed among people who usually trains often (more than 3 times per week; N = 10) in a public sports center (gym), we collected these responses: 100% of respondents

considered physical activities reduce stress; 85% of respondents felt that physical activities are improving mood; 100% of respondents considered physical activities enhance the immune system and 85% of respondents asserted physical activities are affecting subjective perception of pain.

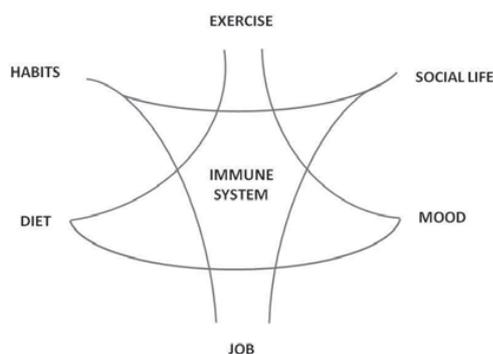
In this article we are explaining the benefits of physical exercise of a certain intensity as achievable during sport practicing. It is known the sentence "no pain no gain", but it is not clear whether or how much pain is required to reach the psychological advantages of sport, for instance, as getting a better mood, being happier or less sad. Scientific data are mainly informing about the possible effects on health with aerobic exercises that are those making heart, lung, sweat gland and whole metabolism to work hard and awaking body to life, but anaerobic ones are also causing changes for good in metabolism and they are barely mentioned in research papers. Pain subjective perception is not the same in sportsmen and sportswomen, compared to sedentary persons [14].

## 2. Physical well-being: Release of Endorphins

Some scientific studies have shown that stress generated in our muscles during sports practicing are helping to release our own tensions [15,16] and to reduce our stress level [4]. The endorphins hypothesis is the most popular explanation about how a physical mechanism is underlying the profits of sports. In the brain, the hypothalamus produces endorphins in the form of peptides and pituitary releases them into blood circulation. Later on, these endorphins are acting on their own receptors. It has been demonstrated *In vivo* that professional runners are releasing endogenous opioids, in the frontolimbic brain regions, after a sustained and intense physical exercise practice. That release is, in fact, closely correlated with perceived subjective euphoria [17].

Therefore, endorphins are neuropeptides which are produced by the body itself and are related to the immune system. It has been shown that immune cells are capable of producing neuropeptides itself, like endogenous opioids and endorphins [6,7]. This fact is pointing out the bidirectional link and the communicative route

between the nervous and the immune systems, that might be improved with sport exercises. Endogenous opioid peptides are released in response to physical exercise, as well as the immunomodulation mechanism is activated [6]. Even the mere gesture of smiling makes us to increase secretion of endorphins [18], however, it is well known that the immune system is affected by many other variables apart from sports. That might be the reason why a casual relationship is so difficult to establish, as it is visually explained in Fig. 1.



**Fig. 1. Schematic visual representation of the possible elements that are affecting our immune system. Multidimensional relationship happening between different variables is visually explained**

The release of endorphins plays a role in adaptive changes during training, reaching its maximum level after 120 minutes of training [19]. However, there are variations between different athletes and their degree of previous training [19], depending on each routine or sport specialization. In resistance exercises, it has been reported changes in endorphin levels, depending on the intensity and time of exercise [20].

Beta-endorphins have been linked to the modulation of production for macrophage cells (Mphi) and for T cells and B cells of the immune system [6,7,21]. Serotonin release has been shown to be of importance for T-cell activation, as well as macrophage accessory functions [6,7]. Thus, playing sports regularly could have an effect over the serotonin release, making stronger our immune systems to better cope with certain diseases or to prevent them to appear. That might happen through the stimulating effect of sport and physical activity on the release of endogenous substances related to immune system. That could be causing an improvement

of the immune response toward infectious agents.

### 3. EMOTIONAL WELL-BEING: PREVENTION OF DEPRESSIONS

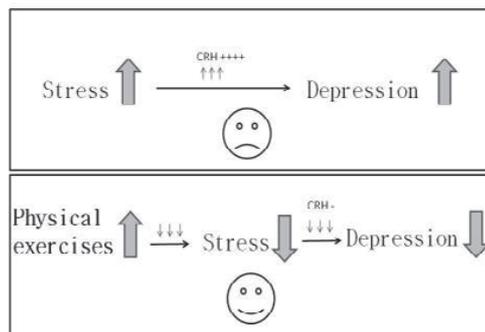
So far, most studies found in scientific literature that have investigated the relationship between physical exercise and levels of depression, are correlational rather than parametrical, indicating a possible preventive effect of depression or a moderate reduction of depressive symptoms instead of a cure. While there is no conclusive evidence that exercise causes a change for the better in the mood, exercise appears to be strongly associated with quite a number of positive changes in mood. It has been demonstrated these positive changes did occur in a group who practiced often exercise and did not occur, at all, in a group who were sedentary [10]. On the other hand, serotonin that is the most extensively studied neurotransmitter of the central nervous system associated with mood changes and antidepressive effects, is increased after physical exercise [6,7].

The vast majority of studies found in scientific literature that research the relationship between physical exercise and psychological variables have used mainly the aerobics exercises while anaerobic sports have been barely studied [4]. On the other hand, it has been evidenced that exercise has to be of sufficient duration and intensity to produce any significant positive psychological effects [10], being for that reason so important discipline and constancy in working out for any good results.

In relation to stress, it has been shown plasma levels of corticosteroids (corticotropin releasing hormone- CRH) may increase the likelihood of depression [22,23]. Therefore, and logically, if a reduction of stress is happening via sports, then that might reduce the risk of depression (Fig. 2).

Moreover, the stimulation of general brain activity has been proven to prevent the risk of neurodegenerative diseases like Alzheimer's, through a possible repairing activational mechanism [2,23]. Consequently, the practice of physical exercise and sports would be activating the motor areas of the brain and that fact could have a long-term beneficial effects through the plasticity of the brain. The same mechanism known as "use it or lose it" for general brain functions has been suggested [24]. Then, physical exercises would be adding gains to the brain health via sports. The plasticity of the motor

cortex related to the movements does exist and it has a very important genetic component in terms of acquisition of motor patterns [25,26]. Then, practicing sports might improve and spread for the good the synaptic connections related to movements in the motor cortex, till reach the incredible levels of abilities and skills of professional athletes. Because it is known as well “there are no strong bodies created under the supervision of weak minds” (personal quote Pauline Nordine).



**Fig. 2. Possible logical relationship between physical exercises and depression, considering the Corticotropin Releasing Hormone (CRH)**

The fatigue that accompanies sport competition is a multifactorial variable related to dehydration, loss of glycogen, muscle damage and mental fatigue. There are several strategies for repairing and recovering the metabolism after intense sport, such as immersion in cold water [3], nutrient intaking, long repairing sleep, stretching, massage stimulation, etc. [27], all of them pursuing to increase the sense of well-being due to sporting. However, fatigue is not perceived the same by different sportsman or sportswoman, depending on their physical preparation, metabolisms, neuromuscular or endocrine specific status [28]. It is interesting to notice fatigue and the feeling of wellbeing related to sport are very often closely linked each other and, like commonly known by population that happens with the Ying and Yang: they can be present and amplify their own meanings because of the existence of the other (Fig. 3).

A different hypothesis about what is causing the positive relationship between physical exercise and psychological wellbeing is based on attentional strategies: Sport might be a distraction for stressful events [29]. The frequent practice of sports or physical exercises in women

might help them to reduce the discomfort of Premenstrual Syndrome (PMS) because attention and concentration are focused on a specific sport activity, that requires a high consumption of energy. That focusing might be blurring the attention to menstrual discomfort, becoming less painful [30].



**Fig. 3. Metaphorical explanation about the possible relationship between sportive pain or discomfort and the physical well-being experience after physical exercise training**

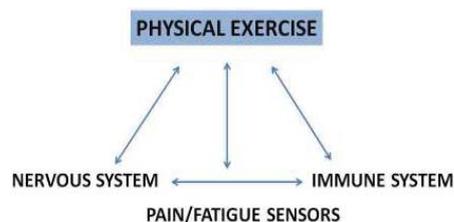
Attention is a complex construct that includes many different functions (alerting or vigilance, orienting and executive or conflict control) and also it is monitored by a complex anatomical brain network which includes right frontal, parietal cortex and thalamus [31]. Chang et al. [32] have demonstrated that in basketball players, under a test of a serial stimuli that were congruent or incongruent, the choice for congruent stimuli is improved after an intense exercise session. This way sports might be improving the attentional resources distribution, depending on specific cognitive complexity, intensity of previous exercise and the sort of congruent and incongruent choice [32]. This improvement in attention resources allocation might enable the sportsman/sportswoman to reduce the attention to pain or annoying stimuli during training. However, further evidences do not exist about the preventive effect of depression via physical activity and more research would be required. But difficulties are guaranteed: patients who are already depressed might have very low motivation to practice any type of physical activity or sport, then effects of sport on depressed patients would be very difficult to research.

#### 4. THRESHOLD DISCOMFORT MODIFICATION

In marathon runners, pain is a common component in their competitions. Some runners

are able to continue their march in extreme tiredness, pain, adverse weather conditions or even, in extreme cases, with fractures [12,14,33]. Pain tolerance is described as the mean between the maximum and minimum intensity of pain a person can endure in successive trials exposed to a noxious stimuli. Runners in marathon usually have significantly increased their tolerance to pain compared to non-runners. This might be due to the increased release of endogenous endorphins, but could also be due to different strategies for coping with the same stress [33]. However, it is important to notice there is not insensitivity to pain in marathon runners, because it was shown marathon runners were able to discriminate better than control group about painful thermal stimuli [12].

Similar effect has been found in women during consecutive exercises: They induced their hypoalgesia response (that is a decreased sensitivity to painful stimuli causing an increase tolerance to pain) after repeated sport trials of an exhaustive exercise [34]. The moderate to intense practice of physical exercises has been related to an increase for pain tolerance in healthy subjects [35]. While physical activity is happening, the activated muscle requires greater specific metabolic components, which are provided by oxygen and blood circulation (testosterone, endorphin, ACTH) [6,36]. Then those compounds are also logically affecting to other metabolic functions in their way to the muscle [37], such as feelings of wellbeing or euphoria, or those improving mood arousal, self perception and increasing pain tolerance. Interconnected variables might be working together in a synergic mechanism as it is visually explained in Fig. 4.



**Fig. 4. Visual representation of the complex interaction between sports and immune system-nervous system and its relation to perception of pain or fatigue. Bidirectional arrows are expressing the bilateral connection that might exist in between them**

Thus, very valid and healthy options to feel better would be sport training sessions, whatever of

these options: Running, biking, body building, fitness, swimming, boxing, kickboxing, taekwondo, etc. However if you prefer to combine mind and body, Pilates or Yoga, as anaerobic exercises with many benefits [38], can also be of great help for health to find physical and psychological core and balance.

## 5. PROPOSAL OF SOME EXERCISES TO BEGIN

For these reasons exposed above, habitual sport would be very convenient for general body and brain health, increasing smoothly the pace, intensity and frequency of physical activity. For this goal it is not required to practice very high intensity exercise or for quite a long time only once per week, but they might be better practiced routinely, making some activity that involves body movement and muscle activation. For instance, as an example, performing a type of aerobic exercise three times a week (medium intensity exercise for 30 or 40 minutes) might be a good beginning. Another good way for beginners could be walking in a quick pace. These exercises suggested by us, might be of good use as a table exercises example for beginners:

- Jogging or walking fast: 4 x 15-30 minutes (mins.); rest 5 mins.
- Elbow plank: 4 x 15-30 seconds (secs.); rest 120 secs.
- Crunches: 4 x 15-20 repetitions (reps.); rest 120 secs.
- Cross crunches: 4 x 15-20 reps.; rest 120 secs.
- Bicycle crunches: 4 x 15-20 reps.; rest 120 secs.

It is important to notice in each physical exercise, every little aspects are important to consider in order to improve its efficiency and efficacy, such as posture, repetitions (reps.), minutes (mins.) and seconds (secs.). These exercises might be of use for a beginner, however, the recommended procedure and proper personal schedule design have to be done and supervised by an expert, depending on each person requirements or needs, for proper activation of muscle groups, those of interest for the person to be trained.

## 6. CONCLUSION

Physical exercise, as individual or collective sport habit practice, has shown improving welfare for health. These gains are including prevention of

certain mood impairments such as depression, strengthening of the immune system, probably via increasing of endorphin release and reducing stress and pain subjective perception. However, these advantages are only reachable when constancy and habitual sports of certain intensity are performed by the subject in his/her personal and individual path of overcoming. Further research would be necessary.

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### COMPETING INTERESTS

Author has declared that no competing interests exist.

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