PHYSICAL FITNESS, A LIFELONG LEARNING BEHAVIOUR IN PREVENTING SARCOPENIA: THE NEED OF AN EDUCATIONAL INTERVENTION

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ABSTRACT

During physiological aging, the striated muscle incurs in reduction of both mass and strength. This phenomenon is called "Sarcopenia". The purpose of this work is, on the one hand, to analyze the most recent literature data on the pathophysiology of Sarcopenia; on the others, it aims to better understand the educational and pedagogical impact of specific physical fitness programs to prevent some of the degenerative processes of the elders including those of the musculoskeletal system. This study wants to demonstrate the importance of physical fitness as an educational intervention with positive effects in clinical, social and pedagogical management of aging and senescence.

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Introduction

The term Sarcopenia comes from the Greek "sarx", which stands for meat and "penia", which stands for loss. Originally coined by Irwin H. Rosenberg (1997)[1] in the late 1980s, it generically defines the involuntary and progressive loss of mass, strength and muscular quality (structural composition, innervation, contractility, capillary density, fatigue and glucose metabolism).

Muscle tissue, which accounts for about 70-80% of the body's cellular mass, as well as having an important role in the function of locomotion, is responsible for the synthesis and maintenance of about 20% of the daily energy expenditure at rest and 25% of total body protein turnover. As a result, the age-related decline in muscle mass leads both to a reduction in muscle strength and to a decline in the efficiency of other muscle functions. Thus, changes in muscle mass have a substantial impact both on motor functions and body metabolism[2].

In recent years, the European Working Group On Sarcopenia (EWGSOP) defined Sarcopenia as a syndrome (multifactorial condition) characterized by a progressive and generalized loss of skeletal muscle mass and strength with the risk of disabilities, limitations in daily activities, and death[3].

In an ever-increasing number of elders, both men and women, this loss of muscular quality is seen as a limitation of individual abilities and capacity to live an independent life as well as a social burden. The phenomenon of aging involves all countries in such a way that the overall aging of the population is destined to emerge as a pre-eminent global phenomenon. It is estimated that Europe will be the area most affected by the phenomenon, with a percentage of elderly people which will reach 35% in 2050; with Spain and Italy as the oldest countries in the world.

Physical activity (PA) is considered one of the most effective prevention strategies to a healthy aging and to retard senescence. In fact, compared to the condition of skeletal muscle, PA can intervene by acting on different molecular mechanisms that induce and / or accelerate aging, such as insulin sensitivity, mitochondrial dysfunction, acceleration of

myonuclear apoptosis and chronic inflammation[4]. To date there is numerous scientific evidence to support this hypothesis, evidence that, even if coming from the most authoritative international organizations, does not come without limitations and controversies because it appears, at times, too general. Before analyzing the evidence, it is crucial to clarify the definitions and terminology of motor activity[5,6].

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscles that requires energy expenditure, besides the consumption when resting". Contrarily, physical exercise (PE) is "a form of physical activity that is planned, structured, repetitive and the improvement or maintenance of fitness is its primary objective". Physical fitness (PF) "includes cardiorespiratory fitness, muscle strength, body composition, flexibility, together with a series of peculiarities that people have or get and that are related to their ability to perform physical activities". Among these definitions, the closest to our idea of exercise like a lifelong learning behavior is that of PF: individuals have to maintain their PF through PE, and fitness remains greater at any age in those who exercise regularly as compared with those who do not[7]. This is the crucial point: the multifactorial process of sarcopenia occurring over a prolonged time period, possibly with no identifiable single cause or mechanism. Therefore, our goal as physical trainer should be to advocate exercise yet be aware of the issues that limit compliance.

The aim of this work is to explain the importance of PF as a complex educational intervention with positive effects in clinical, social and pedagogical management of aging and senescence.

Sarcopenia and Physical Fitness like a complex systemic interaction: the theoretical framework

Despite the precise syndromic framework, there are still conflicting opinions on whether Sarcopenia should be seen as a disease or a process of regulatory aging. Overall, Sarcopenia must be considered a disease only if it reaches levels that lead to severe disability[1]. However, the limits regarding the loss of muscle mass that can be used to define Sarcopenia are not yet clear, thus, the diagnosis of Sarcopenia is based on specific clinical criteria and techniques to assess the presence of reduced muscle mass, function and physical performance[3].

Sarcopenia is a disease characterized by a reduction in muscle mass, a structural alteration of sarcomero proteins and psychophysical weakness.

Very often it has been associated with Dinapenia, a disease that leads to both a gradual loss of strength with aging and to a loss of psychophysical functions. Although there is a high correlation between the reduction of muscle mass, structural alteration of sarcomeric proteins and psychophysical weakness, in recent years it has been shown that muscle strength does not depend solely on the cross-section of the muscle[8]. This displays that it is no longer needed to look at the skeletal muscle as the simple "motor" of the skeletal segments only but rather as a multifunctional organ that allows the translation of the human body system into space in a systemic work involving nervous, endocrine-metabolic and locomotor function.

There is evidence suggesting that Sarcopenia, together with its related disorders, is a potentially modifiable dynamic process characterized by frequent transitions between states over a period of time. This definition suggests that specific interventions and health strategies could be used to prevent, or even postpone, the phenomenon[9]. The American College of Sports Medicine[10] states that participation in regular physical activity elicits several favorable responses that contribute to healthy aging. In this sense, physical exercise has demonstrated its beneficial effects in reducing the risk of many adverse outcomes, such as frailty, the number of falls, poor mental health, decreased cognitive function, decreased cardiac and pulmonary function, decreased physical function, such as balance, gait and mobility, and poor muscular power and functional capacity. All this accumulated evidence indicates that PF is fully recommended both for healthy older, young adults and elderly people with chronic diseases and disabilities[11].

Numerous studies show that human senescence has been delayed for a decade[12,13,14]. This evidence has been fundamental to guide the studies on the biology of human aging, with profound implications for individuals, society and the economy. It was also highlighted that a further delay in the progression of aging is directly dependent on progress in improving health not only for older but also for young people, to achieve a better condition for old age. Much can be done based on existing knowledge, in particular the population can be guided to assume virtuous behaviors from a young age and these concerns fully include PF[13].

Starting with this consideration, we cannot just consider exercise as a drug sport, but we have to propose exercises as a systemic intervention which in-

volve not only the clinical sphere but also the social and pedagogical ones. Only in this way PF can be a compliant activity for older and young people in order to organize a real epidemiological intervention in public health and could become a lifelong learning behavior.

Sarcopenia and Physical Fitness like a complex systemic interaction: the methodological framework

Different types of exercises result in different adaptive responses, but all have an important effect on aging and quality of life. Gymnastic exercises and various ball games improve agility, coordination and balance; stretching exercises help flexibility; resistance exercises, such as weight training, improve muscle mass and strength; endurance exercise, such as walking, cycling or swimming, induces changes in both the cardiovascular system and skeletal muscle, improving its ability to operate aerobic metabolism[15]. Endurance exercises improve the muscle's ability to meet the metabolic demands, therefore, enzymes activity is the main beneficiaries. Resistance exercises improve the muscle's ability to develop tension, therefore, the contractile proteins involved in the production of tension are the main beneficiaries[16].

TYPE	FREQUENCY	DURATION	MODALITY
PHISYCAL FITNESS	3-5 Times a week	Resistance: 1 series, 8-10 exercises for 8-12 repetitions (for older participants 50-60 years), 10-15 repetitions for the weakest. Endurance: the duration depends on the intensity of the activity: low intensity activities should be performed over a longer period of time (30 minutes or more) ; high intensity activities should be performed at least 20 minutes or longer. Flexibility and Balance: 7-10 minutes in all session.	Resistance: progressive and adapted to the individuals. The goal is to provide an adequate stimulus to all muscle groups. Endurance: Given the importance of "total fitness" and that this is achieved more quickly through long-lasting exercise sessions, given the potential risk and problems associated with high intensity activities, moderate intensity activities carried out over a long period are recommended for untrained participants. General indication: 55/65% - 90% of the maximum heart rate (HR max) or 40/50% - 85% of the maximum reserve of oxygen consumption (VO_2R); >55-64% HRmax or >40-49% VO_2R for unhealthy participants. Flexibility and Balance: must be included in a total fitness program to develop and maintain the articular Range of Motion. These exercises should stretch the major muscle groups. Elongation should include both static and dynamic techniques. Balance should include both monopodial and bipedal techniques.

Table 1: Phisycal fitness.

Thus, PF is the best activity indicated to improve the conditions of the skeletal muscle, in young and old population, both in terms of mass and strength and in terms of general metabolism. Base on literature data, in Table 1 we summarize the general recommendations on exercise-based interventions to treat age-associated skeletal muscle mass impairment.

Discussion

Sarcopenia is a disease characterized by a reduction in muscle mass, a structural alteration of sarcomeric proteins and psychophysical weakness[1,17]. Our work investigated in what ways adequate PF can prevent or delay these multifactorial condition. With this work we have evidenced a methodological model of PF which consider exercise a lifelong learning behavior with positive effects on overall clinical, social and pedagogical management of aging and senescence. Despite the evidence already present in literature, it is clear the need for further studies that observe PF in a systemic view such as to give precise indications to both users and fitness operators.

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