

# Physical Exercise Ameliorates Communicable and Non-communicable Diseases

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## Abstract

There has been shown to be present a wide sphere of chronic communicable and non-communicable disease states that are ameliorated by physical exercise schedules, relatively independent of type, duration and intensity, especially if maintained on a chronic-regular basis. It is the case also that the initial milder pro-inflammatory influences, induced by endurance and/or resistance exercise are succeeded by a variety of anti-inflammatory environments/forces are initiated with each succeeding bout of exercise, and long-term anti-inflammatory effects are mediated via an effect upon abdominal, and other unwanted conditions, like adiposity. Physical inactivity and sedentary lifestyle conditions present a public health concern as they contribute to the rising burden of non-communicable and communicable illness. The benefits of exercise have been documented for many diseases with a chronic progression, including obesity, diabetes mellitus, cardiovascular diseases, neurodegenerative diseases, certain types of cancers, and overall mortality, as well as HIV and other disorders acquired through transmission.

**Keywords:** Physical exercise; Communicable; Non-communicable; Diseases; Pro-inflammatory; Anti-inflammatory; Exercise; Amelioration

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## Introduction

Disease and disorder states undergo several stages of the illness-ill-being process: through a relative loss of strength and functionality, followed by fragility and discomfort to incapacity, handicap and several markers of inflammation and sickness; often showing origins at the initial stages of life, there after followed by the secondary and tertiary exposures to an unhealthy lifestyle. Thus, global national policy approaches to physical exercise promotion and induction, on the one hand, and, sedentary behaviour and inactivity, on the other, reduction require much further enhancement in order to reverse the rising rates of non-communicable and communicable diseases. The reassuring and striking bulk of epidemiological, clinical and preclinical-laboratory evidence has reinforced the contention that physical exercise reduces the risk of over thirty-five different disorders/conditions and that exercise programs ought to be prescribed as medical interventions, and indeed preventions,

for a large range of chronic diseases. The existing physiology and molecular biology models of exercise dynamics imply that exercise activates multiple signaling and activational pathways associated major health consequence. Following the initial milder pro-inflammatory influences, anti-inflammatory environments/forces are initiated with each succeeding bout of exercise, and long-term anti-inflammatory effects are mediated via an effect upon abdominal, and other unwanted, adiposity [1,2]. Among those conditions afflicting the integrity and composition of bone tissue, e.g. osteomyelitis, osteosarcoma, metabolic bone disease and osteopenis, which may be viewed as a converging physiological hub of several stimuli of different origin, including dietary, endocrine, nervous, immune, skeletal muscle traction, biomechanical load factors, the eventual integration of which provide: (a) an outcome shape and strength of mineral and protein composition, (b) bloodstream calcium and phosphorous release, and (c) expression and release of hormones and mediators that communicate ongoing bone tissue status for

general physiologic purpose. In this context, the role of physical exercise remains singularly essential, least purporting to neuro-immune propensities, through a dual action pertaining to: (i) the biomechanical load culminating in a direct stimulation of the segment(s) and an indirect load through muscle traction onto the bone, physiological stimulus for bone formation, and, (ii) the endocrine stimulation inducing homeostatic-hormesic adaptation and modification of bone function via the immune system. The epigenetic modifications arising from gene-environment interactions arise from a plethora of incidental and chronic forms of environment with afflictive epigenetic modifications, not least the exposure to transferable, infection and disease for the early and late postnatal life at the developmental stage are induced in utero and postpartum, through exposure to harsh environments/contagion including such agents as endocrine disruptors, severe psychological stress, inactivity and indolence, and insufficient or pathologically excessive nutrition.

## Method

A wide range of these alterations, above, from the necessity and sufficiency of a health-and well-being-maintaining progression are maintained over a chronic period, long-after, the progression from the off-spring's womb-emergence to its tomb-ingression. Unhealthy lifestyles, e.g. unrestricted caloric intake and paucity of diet, insufficiency of exercise, or a lack of stress-coping skills promote the heightened risk for developing an abundance disease, whether lifestyle-related, including essential hypertension, type 2 diabetes mellitus, dyslipidemia, psychological disorders and cancers, or exposure-transmitted, such as sexual, saliva, blood or breathing. The incidence of non-communicable diseases has been increasing markedly, particularly among the so-called developing countries, and the prevention of these diseases presents a high-profile objective for global economic growth, with among several risks to the human condition birth weight deficiencies, morphological abnormality and incidence of pathophysiology and psychopathology, that induce specific epigenetic modifications expressing signalling markers for pathological development during the later stages of life [3,4]. Thus, taken together, the consensus indicates the physical exercise research is advancing at an increased rate than that observed a decade and more ago; nevertheless several outstanding issues remain to be tackled: [a] there is a lack of exercise-sedentary policy research within the low- and middle-income nations, thereby incurring an important limitation of the current body of evidence; [b] the prevailing definitions of current policy vary markedly across studies with most studies not relying on any particular theoretical framework, which or may not constitute an impedance to cross-study comparisons; and, finally, [c] certain studies have employed a spectrum of methods/analyses to assess policy, thereby leading to causative problems pertaining to comparability [5].

The non-communicable diseases, especially chronic cardiovascular disorders, various forms of cancer and diabetes are associated with in excess of 41 million deaths/mortalities annually, of which a third portion are observed before the age of 70 years [6]. Physical inactivity and sedentary lifestyle

conditions present a public health concern as it contributes to the rising burden of non-communicable diseases. Yet there is an abundance of environmental agencies promoting the availability of new and pre-existing public transit options can substantially contribute to increasing low- to moderate-intensity exercise levels, which has the potential to improve health on a population scale thereby inviting both a positive [7], exercise and negative [8], infection-risk, potential. Sedentary lifestyles elevate the risk of several adverse health conditions, such as major non-communicable diseases, as evidenced by cardiovascular disease, metabolic syndrome, and breast and colon cancers, and through the shortening of life expectancy. Nevertheless, physical activity promotion during the last decade has adopted increasingly socioecological-preventive-interventional approaches that place the investigative promoters of physical exercise in their social and environmental context [9]. In a large meta-analysis study, it was shown that aerobic-endurance exercise ameliorated clinical depressive symptoms among patients living presenting a major non-communicable disease, especially among patients presenting cardiac disorders [10]. Similarly, in a comparison of the effects of moderate-versus high-intensity interval training upon vascular function parameters among physically inactive adults, it was found that both conditions experienced alterations in vascular function parameters through which the high-intensity condition was superior as intervention than the moderate condition for ameliorating brachial artery flow-mediated dilation and reducing aortic pulse wave velocity [11]. Social vulnerability, a strong determinant for efficacious health parameters and prognosis, may interfere with the adherence to physical exercise initiatives and schedule, thus it has been observed that among samples within a high social vulnerability context, the adherence to physical exercise programs is low-level, whereas the adult life-related commitments and higher levels of obesity define factors associated with lower adherence levels [12]. In a comprehensive study of juvenile and older Saudi Arabians, it was found that a remarkable proportion of Saudi children, youth and adults were insufficiently physically active and exercising to meet the guideline recommendations linked to levels of moderate-to-vigorous physical exercise with Saudi Arabian female participants expressing disproportionately lesser activity than the male participants, already evident from their early school years onwards [13]. These proportions of Saudi Arabian individuals construed to be at risk for a sedentary lifestyle are inordinately higher than those individuals at risk for several other coronary heart and related diseases. Further, Saudi Arabian boys who were active tended to express favorable levels of blood lipids and body composition profiles in comparison with the sedentary boys.

With the neuro-immune system involved as major players in the control of infections, reparation of injury, and restoration of homeostasis, cells that are participants to the overall functioning of the system are bio-energetically exacting during activation through the requirement of a tightly regulated control of the metabolic pathways, which are to a great extent regulated by two cellular energy sensors, namely, adenosine monophosphate-activated protein kinase and mammalian target of rapamycin. The former contributes to cellular energy homeostasis, largely

to activate glucose and fatty acid uptake and oxidation when cellular energy is low and the latter targets or binds to TOR, 'target-of-rapamycin, and thereby lowers TOR activity, not least among ageing individuals. Exercise intensity, type, endurance or resistance, and duration/schedule in combination with nutrient availability and selection, particularly glucose and glutamine, regulate steadfastly prevailing immune cell differentiation and functioning through the activation of these sensors [14]. During the normal ageing process it has been assumed, either inadvertently or erroneously, that age-associated hyper-inflammatory episodes or "inflamm-aging" are linked to the progression of chronic diseases and have been characterized as an unavoidable aspect of ageing advancement. Nevertheless, these notions fail to take into account the potential anti-inflammatory effects of exercise training and the potential of physical exercise to ameliorate several age-related neurodegenerative and other disorders [15,16]. The anti-inflammatory influences of physical exercise upon bone tissue encompass dual mechanisms also, involving inflammasomes, which provide the receptors of innate immunity regulating caspase-1 by triggering inflammation in response to infections and/or stressors, and skeletal muscle and adipose tissue, that synthesize and secrete the exercise-driven mediators, myokines and adipokines, widespread signalling hormones and anti-inflammatory agents generated by muscle and fat tissue, respectively, affecting the immune function with a net anti-inflammatory outcome [17]; the eventual reversal of dysregulation within these systems renders exercise to be a powerful broker of health and longevity. In this context, adipose tissue capillarization augmentation and distribution benefits metabolic health whereas hypertrophy presents a major contributor to adipose tissue expansion in obesity, since exercise training has induced beneficial effects on adipose tissue remodelling and distribution, whereby aerobic-interval training offers greater efficacy than continuous training in the reduction high fat diet-induced adipose tissue dysfunction [18].

Under conditions of extreme physical the propensity for health benefit and well-being is replaced by the effects of training to exhaustion thereby provoking the expressions associated dysbiosis, the microbial imbalance or maladaptation occurring within or on the surface of the body, e.g. impaired microbiota, of the intestinal microbiome, promoting pro-inflammation and negative metabolic consequences. Exercise presents a viable modulator of the composition of intestinal microbiome due to its links with increased biodiversity and the representation of taxa with potentially beneficial metabolic functions. During prolonged and strenuous exercise, the feelings and symptoms of fatigue-exhaustion that not only occur in chronic and acute disease states, but also as the outcome of extreme pro-inflammatory promulgation. According to Proschinger and Freese [19], exercise-induced exhaustion debility linked to neuro-immune systems affecting brain signalling and the effects of cerebral cytokines play a strategic role in a plethora disease processes, not least metabolic. Activation of the immune system incurs a high-energy cost, also in the brain. In consequence immune cells have high energetic priority over other tissues, such as neurons. A neuronal inactivation and corresponding changes in neurotransmission can also be induced by end products of ATP

metabolism and elicit feelings of fatigue in diseases and after intensive and prolonged exercise bouts [20]. The related issues of sarcopenia and cachexia offer two conditions of fatigue-related reduction of muscle mass, sharing several elements involved in their physiopathogenesis, such as systemic inflammation, impaired muscle protein synthesis, increased muscle apoptosis, mitochondrial dysfunction in skeletal muscle tissue and insulin resistance with features characterized invariably by cancer forms, sedentary lifestyle, CNS-PNS denervation, as well as inflammatory diseases, involving chronic obstructive pulmonary disease, renal failure, cardiac failure, rheumatoid arthritis, inflammatory bowel disease and aging in general. The gastrointestinal tract and gut microbiota are thought to be deeply associated with muscle function and metabolism, so-called "gut-muscle axis" [21,20]. Furthermore, Intestinal dysbiosis has been construed to exist as a contributor of the development of type 2 diabetes, accompanied by intestinal mycetes overgrowth, increased intestinal permeability and systemic low-grade inflammation. Physical exercise improved glycemia, functional and anthropometric variables whereas chronic, regular exercise reduced the intestinal mycetes overgrowth, leaky gut syndrome, and systemic inflammation [22].

## Results

The impact of physical exercise produces positive and dramatic effects through regular physical exercise reduction of the negative influence of HIV on both physical and mental health. In a study comparing people living with HIV with HIV negative control individuals, the investigate factors associated with physical exercise and the assessment of the effect of exercise levels on quality of life and mental well-being were assessed [12]. In agreement with other exercise investigations [23], people living with HIV were found to be less likely to fit the WHO-recommended exercise-level requirements compared to negative-HIV controls and demonstrated significantly lower mental well-being and quality of life scores and further these accompanied among people living with HIV with higher exercise levels that correlated with improved self-rated quality-of-life scores [24]. From a sample of forty female HIV participants, women of age range 20-40, selected carefully from 240 HIV-positive women referred to by the Voluntary Counselling and Treatment Centre who were assigned randomly to either the exercise group (80 min of aerobic and strength training while receiving the VCT's routine services) or control group (n = 20, who received the Voluntary Counselling and Treatment Centre's routine services only), mental health status, and blood samples were assessed [25]. The results indicated that following the exercise intervention program, a significant difference in CD4 cell counts was found between the two groups as well as marked improvements in all the subscales GHQ28 questionnaire, including anxiety disorder, social function, depression and mental health's total score was observed in the exercise compared to the HIV-negative control groups. Among people living with HIV, all improvements in muscle mass and strength maintenance are admirable and accompanied by positive health benefits. Thus, applications of resistance training alone or in combination with aerobic exercise induced positive changes when investigations

with low risk of bias and professional supervision were assessed, depicting improvements in upper and, more essentially, lower body muscle strength together with lower effect on IL-6 levels [26]. Nevertheless, certain comments regarding the suitability of exercise for the enhancement of immune function may be observed: (i) regarding acute exercise, that (a) infection risk is increased; (b) salivary IgA temporarily declines; and (c) transient decreases in the number and function of immune cells in blood represents immuno-suppression the immunological effects of moderate-to-vigorous intensity endurance, e.g. long-distance running, exercise bouts; however, the innate *benefits* of exercise, particularly repeated, chronic exercise, for neuro-immune competency are recommended [27].

## Conclusion

There appears to be a vaguely discernible between what constitutes communicable and/or non-communicable disease states. Nevertheless, putting aside that constraint, the influences of physical exercise, whether endurance-aerobic or resistance or chronic-repeated, are generally manifold in bestowing health advantages against loss of immune system integrity. To many intents and purposes, notions of “transmitted disease” converts the impression, even the reality, of “sexually transmitted disease”; thus, in the interests of clarity of conceptualization a general consensus ought to be discussed further.

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