Neuroscience and Psychiatry: Open Access

Archer, Neurosci Psychiatry 2018, 1:1

Editorial Open Access

Exercise for Cardiovascular Integrity and Plasticity During Ageing

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Editorial

Cardiovascular dysfunction together with various types of heart problems is associated with the ageing process since both impair cardiac function and the afflicted individual's quality-of-life with the eventual curtailment of the life-expectancy of elderly, ageing citizens. Systematic literature reviews and meta-analyses have revealed that the potential of socio-cultural determinants of exercise and diets for health manifestations are identifiable [1]. The impact of voluntary exercise upon a mouse model of non-ischemic dilated cardiomyopathy was evidenced by an improved outcome in non-ischemic dilated heart failure [2]. In a rat model of ageing, low-intensity aerobic exercise along with limb blood-flow restriction may ameiorate ageing-induced muscle atrophy and nicotinic acetylcholine receptors at the neuromuscular junction [3]. It was observed that the restriction of blood-flow concomitant with a mild exercise regime produced potentially amelioraive effects in the protection and augmention of muscle mass and nicotinic acetylcholine receptors clustering at the neuromuscular junction among older rats. Among older women, strength exercise training schedules were beneficial, both for a sustained lifespan and against mortality, if maintained at moderate level of exercise duration, independent of the type or level of aerobic exercise. Among middle-aged or older individuals who presented lower aortic stiffness, without hypertension, habitual bouts of aerobic exercise offered straightforward benefits, as estimated through use of carotid-femoral pulse wave velocity [4-6]. Nevertheless, the extent of aortic stiffness was obseved to be resilient against the influence of clinically-relevant augmentatioon of responses to habitual aerobic exercise when placed in combination with the hypertension displayed by middle-aged and older adults [7], thereby prmoting a form of physiological resilience. In this regard, in observations of older men both the participation in strenuous exercise and the gradual increments of walking-speed that these subjects performed were associated with reductions in all-cause mortality and also in specific mortality, such as cardiovascular disease and heart problems [8]. In a cohort of race-ethnically diversified older female participants (mean age=78.9 years), after adjustment was made for age, wearag time, race-ethnicity, and other potential confounding variables, physical exercise/activity parameters, as assessed through accelerometry, were associated profitably with mean levels of high-density lipoproteins, triglycerides, glucose, C-reactive protein, body mass index, waist girth, and the Reynolds Risk Score [9]. The exercise-induced enhancement of the transcription factor, nuclear erythroid-2-p45-related factor-2, that regulates several antioxidant affecting genes to counteract oxidative damage in several organs, including heart and brain has been observed also [10].

The age-dependent decline in the function of cardiovascular tissues initiates eventually the retardations in cerebral blood flow regulation and maintenance, which in turn, leads to a senscent cascade that culminates in the impairment of neuronal micro-environmental homeostasis. Concurrently, the extremely high level of metabolic activity of the brain and CNS combined with limited capabilities intracellular energy storage places critical demands upon the logistics of cerebral blood-flow to maintain adequately functioning neuronal metabolism. In both Alzheimer's disease and normal-advanced level ageing, cerebral hypoperfusion, increased cerebral blood-flow pulsatility and dysregulation of blood pressure control during orthostatic have been found to be harbingers of exaggerated, age-related deterioration in both cerebrovascular and cardiovascular function with highest levels of all-cause mortality Hazard risk occurring among those individuals presenting limitations of both physical mobility and cognition as opposed to mobility only, cognition only, or no limitation. Although there remains available a great variation of exercise programs, e.g. in the case of cardiovascular vulnerabilities, remarkably analogous benefits and parameters may be expressed, independent of program details, such as the high-intensity interval aerobic training that was given to a group of elderly Japanese men (aged 60-69 years) produced equivalent levelsof feasibility, exercise tolerance and perceived exertion as a traditional moderate-intensity continuous aerobic training. In a population of elderly Turkish citizens (n = 2976) displaying coronary heart disease, it was observed, as a matter of concern, that over 75% were sedentary and 63% were either overweight or obese. It has been shown that brachial shear rate patterns, that affect the endothelium as well as the development and progression of atherosclerosis, and brachial artery intima-media thickness bear relationships to advancing age. Among one hundred-and-two middle-aged and older individuals, who were separated into exercise and control groups, who were submitted to a 12-week interval of aerobic exercise, that the exercise schedule augmented the antegrade shear rate and decreased the retrograde shear rate and brachial artery intima-media thickness. At the same time, the alterations observed in the brachial artery antegrade shear rate together with the retrograde shear rate were related to the alteratio in brachial artery intima-media thickness. In a study of 126 metabolic syndrome diagnosed patients, blood pressure, blood sample, and arterial wall functional and structural variables were assessed before and after the eight-week (84 patients) program of supervised heart-rate targeted aerobic exercise training. Furthermore, among the metabolic syndrome patients, it was observed that there were marked and sgnificant reductions in aortic pulse wave velocity, systolic and diastolic blood pressure, waist circumference, total and low-density-lipid cholesterol, oncurrent with an increase in aerobic capacity, without any hanges among the control subjects. This pattern of results entails that heart-rate targeted aerobic exercise ameliorates aortic stiffness and improvement of metabolic and fitness parameters. Finally,in elderly male patients presenting essential hypertension, both concurrent exercise, these are programs that attempt to concomitantly develop resistance-to-fatigue (through endurance-based exercise) and increased muscle mass (through resistance-based exercise), and aerobic exercise induced post-exercise hypotension although this effect was

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Received January 16, 2018; **Accepted** January 17, 2018; **Published** January 24, 2018

Citation: Archer T (2018) Exercise for Cardiovascular Integrity and Plasticity During Ageing. Neurosci Psychiatry 1: e103.

longer lasting for the aerobic exercise.

There is an ever-increasing necessity to derive lifestyle strategies and related neurobiological mechanisms/tactics for the reduction of ageing-related motor, mood-deficit and cognitive impairments as well as for the advancement of plasticity among the aged. Thus, it has been observed that aerobic exercise could reduce age related decline in cognition and brain functioning. A lifelong adherence to the minimum recommended physical exercise bears a strong relationship with markers of cognitive function and biomarkers of performance as well as neuronal integrity as the ageing process continues [11]. In the laboratory animal model of Brown-Norway/Fischer 344 F1 hybrid rats, expressions of locomotor activity start to deteriorate already during middle age (age level: 12-18 months), accompanied by reduced expression of the glial-derived neurotropic factor family receptor, GFRα-1, which is reduced in substantia nigra [12]. Moderate levels of exercise that were initiated at 18 months of age, implemented the nigral GFRα-1 and tyrosine hydroxylase expression no later than 2 months afterwards. Among the aged rats, the replenishment of ageing-related loss of GFRα-1 in the substanta nigra enhanced tyrosine hydroxylase levels in the substantia nigra alone as well as locomotor activity. Moderate levels of exercise-regimens were ten initiated among a sedentary group of male Brown-Norway/Fischer 344 F1 hybrid rats as a longitudinal effort to evaluate whether or not exercise would ameliorate the ageing-related motor deterioration which initiated at two different age-levels during the later stages of the lifespan (i.e., 18 or 24 months of age). It was observed that the motor deterioration was reversed among the 18-month, but not 24-month-old, group of rats. Nevertheless, the efficacy of exercise intervention among the 18-month-old group was attenuated as the rats reached 27 months old level implying that exercise benefits for plasticity decline as the severity of the condition advances. Among young and ageing mice, exercise training produced a marked enhancement of the long-term potentiation effect for both young and old mice, an upsurge of skeletal muscle Growth Differentiation Factor 11 levels in the young mice and a reduction of Growth Differentiation Factor 11 expression, an ageing biomarker, in the hippocampi of the old mice [13]. In a cohort of 60 sedentary healthy males and females (64-78 years), it was shown that aerobic exercise maintained the course 6 months gave improvements in aerobic capacity that were associated with reduced connectivity between left hippocampus and contralateral precentral gyrus, and linked positively to connectivity between right mid-temporal areas and frontal and parietal regions [14]. The authors concluded that the aerobic exercise intervention employed exerted a limited influence upon patterns of intrinsic brain activity, even though their post hoc analyses suggested that the individual changes in aerobic capacity influenced preferentially mid-temporal brain areas.

The burgeoning indications of exercise-induced resilience and integrity derived from a plethora of different domains gives credence to the notion that the engagement and commitment to healthy lifestyle behaviors, such as physical exercise programs, cognitive and social participation, stress reduction, and resilience training, both alleviate cardiovascular loss of integrity and optimise development of plasticity that accumulate/decline the ageing process. Advantageously, the focus upon multimodality and multi-domain exercise paradigms, such as "exercise-cognition-social-motor skills" programs bestow immeaurable benefits for the ageing not only for cardiovascular integrity and mood elevation but also for the expressions of tissue/behavioral plasticity.

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