[RETRACTED ARTICLE] Exercise and its interactions with various aspects of man and animal lives

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The authors of the article specified below, in agreement with the Editor-in-Chief of this journal, decided on their own initiative to retract that article.
Alerted by Thomson Reuters in June 2013 on the presence of anomalous citation parameters occurred on the calculation of JCR 2012, the Editorial Board of ***Acta Ortopédica Brasileira*** conducted a search for irregular citations in this journal.
The authors reiterate that the scientific content of the article in question does not present any methodological flaws, plagiarism or anything that may disqualify it scientifically, and the reason for its retraction is solely due to the irregular pattern of citations to other journals in its bibliography.

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EXERCISE AND ITS INTERACTIONS WITH VARIOUS ASPECTS OF MAN AND ANIMAL LIVES

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ABSTRACT

To review recently published papers in the Brazilian Scientific press on the general subject of physical exercise. All articles published in 2010/2011 found through the keyword exercise were collected from 11 Brazilian Journals. They were hand filtered to exclude all but original research papers. They were grouped according to subject categories and subcategories. A brief summary of all included articles was produced, comparing similar articles between them. The most commonly found interactions refer to exercise vs. the cardiovascular system, metabolism and the locomotor system, in this order. The volume of scientific research in the field is high and of sufficient quality to justify highlighting.

Keywords: Exercise. Cardiovascular system. Metabolism. Musculoskeletal system.

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INTRODUCTION

In this review we cover papers recently published in the Brazilian scientific press on the locomotor system. We have covered the various fields outlined in Table 1 in search of papers with higher level of citations, within the levels of citations pertaining to each of the respective journals. To this end we applied the concept of continuously variable rating to correct the observed citations with respect to each of the journals, as described by Rocha e Silva.[1] We believe that it is a better way of grading papers in contrast to the more usual procedure of using the impact factor of the published journal to make this evaluation. Subjects discussed in this review fall naturally into the categories in which exercise might be expected to be a significant factor

METHOD

We selected a collection of SCIELO/SciMAGO indexed Brazilian journals in which we might reasonable expect to find articles on the general topic being studied. The following journals were: Anais da Academia Brasileira de Ciências, Arquivos Brasileiros de Endocrinologia & Metabologia, Clinics, Brazilian Journal of Infectious Diseases, Brazilian Journal of Medical and Biological Research, Jornal de Pediatria, Memórias do Instituto Oswaldo Cruz, Revista Brasileira de Medicina do Esporte, Revista da Escola de Enfermagem da USP, Revista Latino-Americana de Enfermagem, and São Paulo Medical Journal. The only keyword used was exercise, and date limits were established as 2010-2011. An initial list of 161 articles was detected. These were hand-picked to exclude all but original research articles. In a few cases the keyword exercise did not refer to the theme of this review and were likewise excluded. A final list of 77 articles, covering issues summarized in Table 1 was finally selected. Articles were then divided into categories and subcategories and briefly discussed.

RESULTS

The general distribution of subject matter is in no way surprising. It stands to reason that the most intensely researched subjects would be the top three in Table 1, namely, the interaction of exercise with the cardiovascular system, with metabolism and with the locomotor system. What follows is a brief summary of what these articles discuss and is offered as a guide to the readership of Acta Ortopédica Brasileira.

Cardiovascular system: The effects of exercise on hypertensive patients have been discussed as they affect pressure responses or stress. Souza Nery et al.[2] described blood pressure responses during resistance exercise in 10 hypertensive and 10 normotensive subjects in order to determine whether an exercise protocol alters these responses. They conclude that resistance exercise increased systolic blood pressure considerably more in hypertensive than in normotensive subjects, and this increase was greater

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Table 1. Subject matter of the articles selected in this review. The sum is larger than the number of references because many articles are significant to more than one subject matter.

Subject matter	Number of articles
Cardiovascular System	24
Metabolism	13
Locomotor System	10
Pulmonary System	8
Endocrinology	8
Psychiatry	5
Geriatrics	4
Nociception	4
Pediatrics	4
Rheumatology	3
Gynecology	3
Immunology	2
Use of Tobacco	2
Other	4

when lower-intensity exercise was performed to the point of exhaustion. Medeiros et al.[3] investigated the hemodynamic responses to mental stress before and after a bout of exercise in 18 subjects with prehypertension vs. 16 normotensive controls, who underwent a mental stress test before and after a maximal cardiopulmonary exercise test on a treadmill. They found that subjects with prehypertension had elevated blood pressure and a blunted vasodilator response during mental stress, but their blood pressure was attenuated and their vasodilator response was normalized after a single bout of maximal dynamic exercise.

Four animal studies were selected: in three of these spontaneously hypertensive rats were used, whereas in one a 2-kidney,1--clip model was investigated. Carneiro-Júnior et al.[4] determined the effects of exercise training and detraining on the morphological and mechanical properties of left ventricular myocytes in 4-month-old spontaneously hypertensive trained vs. sedentary rats and found that cell length was greater in trained vs. sedentary and remained so after detraining, whereas cell width and volume were unaffected by either exercise training or detraining. They conclude that exercise affected left ventricle remodeling in SHR towards eccentric hypertrophy, which remained after detraining. It also improved single left ventricular myocyte contractile function, which was reversed by detraining. Barros et al.[5] evaluated cardiac remodeling and the role of adenosine in cardiac blood flow distribution to the myocardium after aerobic physical training in 28 male spontaneously hypertensive rats, pups and adults submitted to a swimming training protocol. They conclude that training induced cardiac hypertrophy, as well as increased adenosine formation, leading to higher coronary blood flow, with an important role in hypertension regulation. The morphological ultrastructure of the heart was the subject matter covered by Garcia.[6] who studied the beneficial effects of low--intensity physical activity on structural and ultrastructural renal morphology and blood pressure in spontaneously hypertensive rats. They found that exercised hypertensive rats showed a significant blood pressure reduction of 26%, with improvements in the following renal structures of exercised rats: interdigitations of the proximal and distal convoluted tubules; basal membrane of the proximal and distal convoluted tubules; basal membrane, slit diaphragm and pedicels of the glomerular filtration barrier, with a decreased expression of connexin-43. They claim that physical exercise could be a therapeutic tool for improving kidney ultrastructure and, consequently, renal function in hypertensive individuals. In a different hypertension model, the 2K1C, Soares et al.[7] compared the effect of exercise training with or without a 3% workload on different cardiac and renal parameters in renovascular hypertensive (2K1C) male Fisher rats. In contrast to what was described by Carneiro-Júnior et al.[4] concentric left ventricle hypertrophy was prevented by exercise without a workload, with decreased myocyte diameter and vasculature thickness. Work loaded exercise further reduced concentric remodeling and prevented the increase in cardiac vasculature wall thickness, with decreased myocyte diameter and increased collagen deposition. Renal morphometric analysis showed that work loaded exercise induced an increase in vasculature wall thickness and collagen deposition in the left kidney. They thus claim that unloaded exercise was more beneficial effects than work loaded workout in renovascular hypertensive rats.

Coronary artery disease was the subject of a human study Machado et al.[8] who compared the behavior of heart rate (HR) and HR variability during different loads of resistance exercise in 10 patients with clinically stable coronary artery disease vs. 10 healthy sedentary controls. They described an increase in HR when comparing pre-effort rest and 40% 1RM in both groups and conclude that loads up to 30% 1RM during incline bench press result in depressed vagal modulation in both groups, although only stable CAD patients presented sympathetic overactivity at 20% 1RM. Experimental acute myocardial infarct was studied by two different groups: Galvão et al.[9] investigated the effect of opioid receptor blockade on the myocardial protection conferred by chronic treadmill exercise and compared exercise training with different strategies of myocardial protection (opioid infusion and brief periods of ischemia-reperfusion) preceding irreversible left anterior descending coronary ligation in male Wistar rats: They found that exercise training, morphine infusion, intermittent ischemia-reperfusion preconditioning, exercise training plus morphine resulted in a smaller infarct area vs. controls, which was annulled by naloxone alone or naloxone plus exercise. They conclude that the effect of chronic exercise training in decreasing infarct size seems to occur, at least in part, through the opioid receptor stimulus and not by increasing myocardial perfusion. A contrasting result is described by Veiga et al.[10] who investigated whether previous exercise training could prevent or attenuate acute cardiac alterations after myocardial infarction in female Wistar rats submitted to swim training or allowed to remain sedentary. Their results indicate that previous swim training does not attenuate systolic and diastolic function alterations after myocardial infarction induced by left coronary artery occlusion, suggesting that cardioprotection cannot be provided by exercise training in this experimental model. It is not possible to determine why these two projects resulted in apparently contradictory response, but the answer may lie in the different types of exercise.

The effects of exercise on patients with myocardial insufficiency was investigated in three different pathological conditions: Gimenes et al.[11] determined the response characteristics and functional correlates of the dynamic relationship between peak O_2 consumption vs. power output during ramp-incremental

exercise in 14 patients with mitochondrial myopathy vs. 10 sedentary controls through a ramp-incremental cycle ergometer test. As expected, peak O_2 consumption and muscle performance were lower in patients vs. controls. Authors claim that a readily available, effort-independent index of aerobic dysfunction during dynamic exercise (O_2 consumption/power output) is typically reduced in patients with mitochondrial myopathy, being related to increased functional impairment and higher cardiopulmonary stress. Myers et al.[12] examined the association between cardiac performance and the severity of heart failure, as determined by clinical and cardiopulmonary exercise test responses and claim that impaired cardiac output recovery kinetics can identify heart failure patients with more severe disease, lower exercise capacity, and inefficient ventilation. Estimating cardiac output in recovery from exercise may provide added insight into the cardiovascular status of patients with heart failure. Guimarães et al.[13] who evaluated the norepinephrine plasma level in 20 heart transplant recipients and compared it with that in 11 heart failure patients and 7 healthy subjects during rest and just after a 6-minute walking test. At rest, norepinephrine plasma levels were similarly higher in heart transplant recipients and healthy subjects, but after a 6-minute walking test, heart transplant recipient's norepinephrine plasma level was no different from that of heart failure patients and both were higher than healthy subjects.

Angiology was the subject of four studies, two in patients, and two in animal models. Cucato et al.[14] examine the acute effects of resistance exercise on post-exercise blood pressure in 8 patients with intermittent claudication.Systolic, diastolic and mean blood pressures decreased significantly after the exercise session throughout the entire recovery period suggesting that acute resistance exercise may decrease cardiovascular load in these patients. Marfan syndrome patients were studied by Teresi et al.[15], who analyzed the acute effect of submaximal exercise on aortic distensibility using pulse wave velocity and other hemodynamic variables in Marfan syndrome patients with mild or no aortic dilatation. The final heart rate and final systolic arterial pressure were higher in the control group than in the patients, but no difference in pulse wave velocity in Marfan syndrome patients was observed. Bruck-Nascimento et al.[16] investigated the effects of the androgenic-anabolic steroid nandrolone, exercise (swimming) and stress (2h immobilization) on the vascular responses of male Wistar rats. Exercise was started at 8 weeks of life. One group received nandrolone (5 mg/kg, twice per week for 8 weeks). Exercise sessions were preceded by acute immobilization stress. Curves for noradrenaline were obtained for thoracic aorta, with and without endothelium from sedentary and trained rats, submitted or not to stress, treated or not with nandrolone. They found that stress and physical exercise determine similar vascular adaptive response involving distinct mechanisms as indicated by the observation that only the physical exercise-induced adaptive response was abolished by nandrolone. Brito et al.[17] evaluated the late effects of multicarencial malnutrition imposed during lactation and the possible effects of moderate aerobic training on the luminal diameter and the tunica media area of the left common carotid artery, horizontal aorta and thoracic aorta of rats throughout the aging process. They conclude that malnutrition induced partial changes in the horizontal aorta wall, whereas physical training promoted changes in the tunica media area of the left common carotid artery and luminal diameter of the thoracic aorta.

The interaction of cardiac function and exercise in healthy humans or rats was studied in five papers. We start with a murine model on the effects of aerobic training and anabolic steroids in which Do Carmo et al.[18] studied the cardiac on the cardiac structure and function in Wistar rats submitted to swimming. Untreated trained controls showed reduction in resting heart rate, which did not occur in anabolic-treated trained animals, which also presented decrease in diastolic function in relation to other groups. Untreated trained groups showed increases in cardiomyocytes diameter, whereas anabolic-treated groups showed an increase in the collagen volumetric fraction. Thus, anabolic steroid treatment associated with swimming training induces concentric hypertrophy by increased interstitial collagen, leading to loss of diastolic function.

Two interesting papers by Perim et al.[19,20] examined relative O_2 pulse curves in elite soccer players at maximal heart rate during treadmill cardiopulmonary exercise testing. They conclude that relative O_2 pulse curve slopes, which serve as an indirect and non-invasive surrogate for stroke volume, suggest that the stroke volume is similar in young and aerobically fit subjects regardless of the maximum heart rate reached. They also find that no increase in relative O_2 pulse at peak effort could represent a physiologic stroke volume limitation in these athletes.[20] The same theme is taken up by Oliveira et al.[21], who found that the Exercise Oxygen Pulse (O_2 pulse), a surrogate for stroke volume and arteriovenous oxygen difference, exhibits a stable linear pattern in subjects reevaluated under equivalent clinical conditions. Post exercise hypotension was examined by Casonatto et al.[22] who investigated the effects of aerobic exercise on the acute blood pressure response and on the indicators of autonomic activity after exercise in 10 young male subjects who underwent four experimental exercise sessions and one hi-intensity session on a cycle ergometer. Somewhat surprisingly, the study found no reduction in blood pressure after exercise, although measurements of autonomic neural activity revealed parasympathetic recovery tends to be slower in high intensity exercise but that sympathetic withdrawal may apparently compensate for this delayed recovery. Still on post exercise hypotension, Farinatti et al.[23] evaluated heart rate (HR), systolic blood pressure (SBP), and rate-pressure product during and after large and small muscle group flexibility exercises performed simultaneously with the Valsalva Maneuver by 22 asymptomatic volunteers. Blood pressure and the rate pressure product increased throughout the exercises, but no post-exercise hypotension was detected. Greater pressure increases were related to the Valsalva maneuver and to a larger stretched muscle mass. They conclude that both the stretched muscle mass and the Valsalva maneuver influence acute cardiovascular responses to multiple-set passive stretching exercise sessions.

The relation between metabolic syndrome and cardiovascular risk was studied by Marcon et al.[24] who evaluated the impact of a minimum program of supervised physical exercise on functional capacity and cardiometabolic risk in patients with morbid obesity, pre- and post-program, and found significant changes in weight (decreased), distance in the 6-minute walking test (increased), systolic pressure (decreased), diastolic pressure (decreased) and Framingham Score Risk (decreased). They claim that a supervised exercise program of low intensity and frequency might interfere positively in cardiometabolic risk in individuals with morbid obesity.

A genetic study conducted by Esposti et al.[25] endeavored to determine whether a single nucleotide polymorphism of the endothelial NO synthase (eNOS) gene at positions -786T>C, G894T (Glu298Asp) and at the variable number of tandem repeat Intron 4b/a would interfere with the cardiometabolic responses of trained postmenopausal women. Blood pressure was reduced after training, which was genotype-independent, but women without the studied eNOS gene polymorphism and Intron 4b/a (bb genotype) presented a better reduction of total cholesterol levels in response to training compared to those who carried the mutant allele. They conclude that women without eNOS gene polymorphism at position -786T>C and Intron 4b/a showed a greater reduction of plasma cholesterol levels in response to training.

Metabolism: The interaction of exercise with metabolism was the second highest occurrence, another expected outcome of the literature search. Six papers were devoted to human studies, seven to animal models. Navalta et al.[26] endeavored to determine whether cognitive awareness of carbohydrate beverage consumption affects exercise-induced lymphocyte apoptosis, irrespective of actual carbohydrate intake. Carbohydrate supplementation during aerobic exercise generally protects against the immunosuppressive effects of exercise but it is not currently known whether carbohydrate consumption or simply the knowledge of carbohydrate consumption also has that effect. They claim that neither carbohydrate nor placebo supplementation altered the typical lymphocyte apoptotic response following exercise. While carbohydrate supplementation has an immune-boosting effect during exercise, it appears that this influence does not extend to the mechanisms that govern exercise-induced lymphocyte cell death. As seen earlier, the relation between metabolic syndrome and cardiovascular risk was studied by Marcon et al.[24] who conclude that a supervised exercise program of low intensity and frequency might interfere positively in cardiometabolic risk in individuals with morbid obesity. The other present interaction of AIDS with nutrition was the subject matter of Souza et al.[27], who prospectively evaluated eleven HIV affected patients living vs. 21 controls older than 50 years and without prior regular physical activity. A one-year progressive resistance exercise program was instituted. Initially, HIV patients were lighter and weaker than controls, but their strength increased faster nullifying initial differences. These effects were independent of gender, age or baseline physical activity. HIV patients improved fasting glucose levels. They conclude that resistance exercise safely increased the strength of older patients living with HIV adults, allowing them to achieve performance levels observed among otherwise healthy controls and claim that resistance exercise should be prescribed to HIV afflicted adults. On a different note, Faria Coelho et al.[28] investigated the effects of L-carnitine supplementation, on the resting metabolic rate and oxidation of free fatty acids under rested or exercised conditions in 21 overweight active volunteers. They conclude that carnitine supplementation caused no changes in the variables analyzed in this study. Two papers look at lipidic profile of normal fit individuals undergoing exercise. Zanella et al.[29] evaluated whether lipid profile, apolipoprotein A-1 and malondialdehyde have any relationship with physical exercise by comparing footballers with their relatives and with sedentary controls. Footballers had lower levels of total cholesterol LDL-cholesterol fraction, apolipoprotein A-1, but higher HDL-cholesterol compared to their relatives. They also had reduced levels of malondialdehyde compared to their relatives and to the sedentary controls. These results suggest an association between physical exercise and lower levels of malondialdehyde in the footballers and that physical activity seems to promote beneficial effects on the lipoproteins, regardless of genetic influences. Ferreira et al.[30] investigated the effect of intense intermittent *versus* moderate continuous exercise using the same energy expenditure in postprandial lipemia in 20 healthy men (aged 21.5 ± 3.5 years) who performed a random sequence of no exercise, intense intermittent, or moderate continuous exercise. Each test series was completed 30 min before ingestion of a high-fat meal (1 g fat/kg). Intense intermittent and moderate continuous exercises reduced postprandial triglycerides, but only intense intermittent exercise reduced postprandial very low density lipoprotein. Both exercises produced lower levels of insulinemia. They conclude that intense intermittent or continuous exercise completed 30 min before ingestion of high-fat meal reduced postprandial lipid levels in physically active men.

Seven articles describe animal models of exercise as relating to metabolic factors. The first two look at a similar problem from two different angles and arrive at similar conclusions. Monteiro et al.[31] evaluated the effects of physical training of mother Wistar rats during pregnancy associated with a low-protein diet offered during pregnancy and lactation on the development and growth of the femur of their offspring. Pups were divided into offspring of sedentary nourished or malnourished mothers, pups of trained nourished or malnourished mothers. Decreased body weight, femur weight, and femur length were observed for pups from malnourished mothers, with no difference in bone mineral content of the femur in either of the groups. Mild physical training on the treadmill during pregnancy did not interfere with bone development and growth of the offspring. Dantas et al.[32] evaluated the effects of chronic treadmill training on body mass gain and visceral fat accumulation in overfed newly born rats. Overfeeding was induced by reducing the litter size to 3 male pups per mother during suckling, while control litter size was adjusted to 10 male pups per mother. The higher body weight gain during suckling in the overfed rats was attenuated by exercise. Overfed rats showed higher visceral fat weight compared to normally fed animals. Exercise reduced visceral fat normal and overfed rats. Still on the theme of obesity, Marques et al.[33] evaluated the effects of exercise training on carbohydrate metabolism, lipid profile, visceral adiposity, pancreatic islet alterations, and nonalcoholic fatty liver disease between normally fed and overfed obese C57BL/6 mice. Normal or high-fat mice were divided into sedentary and exercised groups. High fat mice had 65% more body mass but exercise reduced it by 23%. They also had high hepatic enzymes and plasma insulin and hypertrophic pancreatic islets. Exercise significantly reduced liver steatosis and islet size in high fat animals and attenuated all the changes due to high fat. Three papers covered metabolic markers of hyperactivity in exercised rats. Araujo et al.[34] endeavored to verify the swimming training periodization responses on aerobic and anaerobic performance, glycogen concentration in muscle (M) and liver (L), and creatine kinase (CK) in rats, separated into a sedentary and a training periodization group during a period of 12 weeks. The Lactate Minimum Test was adapted to determine the aerobic capacity. Anaerobic performance was evaluated by maximal exhaustion time. Authors claim that training periodization in rats acted as an important tool to

evaluate specific metabolic effects of training. This is supported by sensitive responses of the rats along the blocks, based on improvement of aerobic and anaerobic performance as well as glycogen concentration obtained after the taper block. Freitas et al.[35] investigated the effects of low intensity aerobic swimming training on blood lactate and glucose responses in 12 adult male Wistar rats during exertion test randomly divided into sedentary and trained. After the last training session all animals were submitted to two 20-minute swimming tests, unloaded or with a load of 5% of body weight. Blood lactate and glucose correlated negatively during the exertion tests. Trained rats had lower lactate levels than sedentary animals in both exercise tests. Blood glucose declined with exercise in sedentary rats during the loaded test, but remained stable in trained animals in both exercise tests. Menezes et al.[36] examined the fitness of 40 Wistar rats in treadmill training through the measurement of the concentration of lactic acid in the blood serum. A maximum effort routine was applied at every ten days for 40 days. Lactic acid decreased progressively throughout; At 30 and 40 days, there were significant differences between initial and final tests regarding speed and time. They conclude that rats submitted to physical training present better metabolic capacity and that with suitable training, the physical fitness increased with the physical effort. The final paper on nutrition has been previously discussed. Brito et al.[17] evaluated the late effects of malnutrition during lactation and aerobic training on the structure of the left common carotid artery, horizontal aorta and thoracic aorta of rats throughout aging and claim that malnutrition induced partial changes in the horizontal aorta wall, whereas physical training promoted changes in the tunica media area of the left common carotid artery and luminal diameter of the thoracic aorta.

The Locomotor System: Out of 10 papers on the interaction of the locomotor system with exercise, three deal with structural effects on muscle and two on bone. Cleto et al.[37] studied the activation of lipid peroxidation and nuclear factor-κB (NF-κB) in skeletal muscle, and the plasma cytokine profile following maximum progressive swimming in 15 adult male Swiss mice divided into three groups: immediately after exercise (EX1), 3 h after exercise (EX2) and control. Exercising mice swam until exhaustion. Controls were kept immersed in water for 20 min. Swimming generates reactive oxygen species and NF-κB activation in skeletal muscle, increased plasma interleukin-6 and reduced Interleukin-10. These results were attributed to exercise type and intensity. Camarço-Filho et al.[38] analyzed the adaptations of the skeletal musculature to the interaction between physical activity practice and cigarette smoke exposure and conclude that the interaction between cigarette smoke exposure and physical activity during 15 days accentuated the histological changes in the soleus muscle, causing an alteration in the enzymatic activity and increase in the fiber diameter. Da Silva et al.[39] endeavored to verify whether a low-intensity swimming program protects the skeletal muscles against damage induced by exhaustive exercise. Male Wistar rats were randomly divided into four groups: sedentary control; sedentary submitted to exhaustive test; swimming trained; swimming trained submitted to exhaustive test. They conclude that although a low-intensity swimming training increased the animals' performance in the exhaustive exercise test, it did not protect their skeletal muscles against damage induced by exhaustive exercise.

Two articles discuss exercise and bone development. Esteves et al.[40] assessed the effect of swimming on somatic development and bone growth of female rats subjected to two experimental models to reproduce hormone deficiency. Neonate female Wistar rats were separated into a monosodium glutamate treated and a saline treated group. At 60 days of life, the monosodium glutamate group was ovariectomized and saline group only went through surgical stress. Subsequently, half of the animals in each group started the swimming training, resulting in four experimental groups: sedentary or swimming saline, sedentary or swimming glutamate ovariectomy. They conclude that swimming helped the weight of the femur in the saline group but did not alter it between sedentary vs. exercised glutamine rats. We have already reviewed this paper by Monteiro et al.[31] who evaluated the effects of physical training of mother Wistar rats during pregnancy associated with a low-protein diet offered during pregnancy and lactation on the development and growth of the femur of their offspring and found thatmild physical training on the treadmill during pregnancy did not interfere with bone development and growth of the offspring.

Clinical studies on athletes account for five papers: Knechtle et al.[41] investigated the relationship between skin-fold thickness and running performance from 100 m to the marathon distance to determine whether anthropometry characteristics or training practices were related to race time in 42 recreational female half marathoners to determine the predictor variables of half-marathon race time. Observational field study at the 'Half Marathon Basel' in Switzerland. They claim anthropometric and training variables were related to half-marathon race time in recreational female runners. Skin-fold thicknesses at various upper body locations were related to training intensity. High running speed in training appears to be important for fast half-marathon race times and may reduce upper body skin-fold thicknesses in recreational female half marathoners. The two papers by Perim et al.[19] have been discussed: one compared relative O_2 pulse curves in 180 elite soccer players at their maximal heart rate during treadmill cardiopulmonary exercise testing and concludes that relative O_2 pulse curve slopes, which serve as an indirect and non-invasive surrogate for stroke volume, suggest that the stroke volume is similar in young and aerobically fit subjects regardless of the maximum heart rate reached. The second[20] analyzed the stability of the O_2 pulse curve relative to body mass in 49 elite soccer players and claims that in young healthy men in good to excellent aerobic condition, the morphology of the relative O_2 pulse curve is consistent up to close to the peak effort for a maximal cardiopulmonary exercise test repeated within a 1-year period. No increase in relative O_2 pulse at peak effort could represent a physiologic stroke volume limitation in these athletes. The article by Zanella et al.[29] evaluating lipid profile, apolipoprotein A-1 and malondialdehyde vs. physical exercise by comparing footballers with their relatives and with sedentary controls suggests an association between physical exercise and lower levels of malondialdehyde in the footballers and that physical activity seems to promote beneficial effects on the lipoproteins, regardless of genetic influences.

The last paper in this section deals with negative addiction to exercise, by Modolo et al.[42] who endeavored to determine if there are differences between male and female athletes' scores on measurements of negative addiction symptoms, quality of life, mood and sleep. 144 female and 156 male athletes participated in this study by answering the following

questionnaires: Negative Addiction Scale, Beck Depression Inventory, Trait Anxiety Inventory, Profile of Mood States, SF-36 Quality of Life, Pittsburgh Sleep Quality and Epworth Sleepiness Scale. No differences were seen in the development of negative addiction exercise symptoms in males and females and there were no changes in the quality of life and mood of these athletes.

Pulmonary System: Eight original papers examine the interaction of exercise with respiratory function, seven of which look at human situations, one at development in a murine model. Two papers describe relations with bronchiolitis obliterans. Mattiello et al.[43] assessed functional capacity during exercise in 20 children and adolescents with post-infectious bronchiolitis obliterans. The 6-minute walk test and pulmonary function tests were studies. They found that the majority of these post--infectious bronchiolitis obliterans patients exhibited reduced functional capacity, both through pulmonary functional testing, or the 6-minute walk test. They suggest that due to its greater feasibility, the 6-minute walk test could be an alternative where pulmonary function testing is not available. Bosa et al.[44] assessed associations of clinical and nutritional factors of 57 children and adolescents with bronchiolitis obliterans. High percentages of malnutrition and risk for malnutrition, such as low muscle reserves, were noted although fat reserves, although fat reserves were normal. Compromised pulmonary function was associated with poor performance at exercise, while malnutrition and low muscle reserves were negatively associated with the 6-minute walk test. Their results emphasize the need for nutritional intervention, and suggest that, in addition to weight and height indices for nutritional assessment, it is necessary to analyze body composition, so that more undernourished patients may be identified and correctly managed.

Asthma was the subject of two papers. Wichert et al.[45] investigated the medium-term benefits of a 3-month swimming program in schoolchildren and adolescents with moderate persistent atopic asthma. They found that children and adolescents with moderate persistent atopic asthma subjected to this swim program experienced a significant decrease in bronchial hyper responsiveness. When compared with untrained asthmatic controls swimmers also showed improvement in elastic recoil of the chest wall. Gomieiro et al.[46] evaluated the effects of a respiratory exercise program tailored for 14 elderly individuals with asthma after a 16-week respiratory exercise program, and found that that respiratory exercise resulted in increased muscle strength and was associated with a positive effect on patient health and quality of life. Therefore, such training should be included in the routine therapeutic approach in older adults with asthma.

Chronic obstructive pulmonary disease (COPD) was studied by Costa et al.[47] who investigated the respiratory pattern of chronic obstructive pulmonary disease patients during different upper limb exercises associated with respiratory exercises in 15 chronic obstructive pulmonary disease patients. Respiratory pattern analysis was performed during four types of upper limb exercises, two shoulder flexion-extensions and two shoulder abduction-adductions (inspiration or expiration, respectively). Thoracoabdominal coordination increased in the two inspiration-exercise types during shoulder flexion or abduction differing from the exercises with expiration at the time of shoulder flexion and horizontal abduction. They claim that exercises performed with inverted respiratory time produced less asynchrony and can be used as important strategies during physical exercise programs in these patients.

Healthy volunteers were the subject of two studies. Castro et al.[48] compared respiratory responses, (time-domain variability of ventilatory components during progressive cardiopulmonary exercise tests performed on cycle or arm ergometers) in 12 healthy volunteers following a ramp protocol. There were no significant differences in the timing of breathing throughout the exercise when the cycle and arm ergometer measurements were compared. However, the arm exercise time-domain variabilities for the minute ventilation, tidal volume and respiratory rate were significantly greater than the equivalent values obtained during leg exercise. Although the type of exercise did not influence the timing of breathing when dynamic arm and leg exercises are compared, it does influence time domain ventilatory variability of young, healthy individuals. Perini et al.[20] analyzed the stability of the O_2 pulse curve relative to body mass in 49 elite soccer players. O_2 consumption, heart rate (HR), and relative O_2 pulse were compared at every 10% of the running time in two maximal cardiopulmonary exercise tests and conclude that in young healthy men in good to excellent aerobic condition, the morphology of the relative O_2 pulse curve is consistent up to close to the peak effort for a maximal cardiopulmonary exercise tests repeated within a 1-year period. No increase in relative O_2 pulse at peak effort could represent a physiologic stroke volume limitation in these athletes.

In the only animal model in this section, Silva et al.[49] investigated mitochondrial adaptations and oxidative stress markers after trial and eight weeks of running training in liver of mice distributed into untrained, four week trained, or eight week trained. The results show that endurance training (8-wk) increased the succinate dehydrogenase activity, superoxide dismutase and total thiol content in liver when compared to untrained animals. Decrease in protein carbonylation in the respective group in relation to UT was also observed. They conclude that eight weeks of running training are necessary for mitochondrial respiratory chain enzyme activities to increase and improvement in oxidative stress markers in liver of mice.

Endocrinology: The interaction of exercise with the endocrine system appears in eight papers. Three deal with diabetes. Silva et al.[50] evaluated the effect of smoking and associated moderate physical activity on the insulin sensitivity in the heart by GLUT4 gene expression and found that smoking reduces insulin sensitivity and the cardiac ability in uptaking glucose, which can be reversed by moderate physical exercise. Rossi et al.[51] investigated the effects of chronic low-to moderate-intensity swimming training on thermal pain sensitivity in 51 streptozotocin-induced diabetic Wistar female rats. After eight weeks of swimming, streptozotocin-induced diabetic rats presented a significantly lower body mass compared with the normoglycemic groups, but no differences occurred in blood glucose levels between the trained or sedentary groups of hyper- or normoglycemic rats. In the pain sensitivity test, the rats from the hyperglycemic trained group presented a significantly lower latency than the other rats. They suggest that low-to-moderate swimming training for a long duration reduces thermal hyperalgesia in diabetic rats. Panveloski-Costa et al.[52] endeavored to determine if a resistive exercise protocol can modulate Tnf-α, SOCS3 and glucose transporter GLUT4 genes expression in skeletal muscle, and peripheral insulin sensitivity

in obese rats induced by hyperlipidic diet. The mRNA content of Tnf-α and SOCS3 increased in skeletal muscle sedentary but decreased in exercised animals. GLUT4 mRNA were not different between groups. Peripheral insulin sensitivity increased in the sedentary vs. exercised rats. They conclude that resistive exercise reverses the peripheral insulin resistance and the inflammatory state in skeletal muscle in diet-induced obese rats.

Two papers deal with the exercise thyroid interaction. Vigário et al.[53] evaluated the functional and hemodynamic responses during exercise and recovery in 29 patients with subclinical hyperthyroidism on TSH-suppressive therapy (levothyroxine) for thyroid carcinoma vs. 35 euthyroid subjects. All volunteers underwent cardiopulmonary exercise testing on a treadmill and functional and hemodynamic variables were measured during exercise and recovery. The patients showed impaired functional response to exercise, marked by lower values for oxygen consumption and exercise duration in addition to premature achievement of the anaerobic threshold. Heart-rate and blood pressure recovery immediately after exercise were slower among the patients when compared to euthyroid subjects. Thus it was shown that subclinical hyperthyroidism is associated with impaired functional and hemodynamic responses during exercise and its recovery. Mainenti et al.[54] investigated the effects of levothyroxine on cardiopulmonary exercise reserve and recovery in subclinical hypothyroidism in 23 women, 44 years old submitted to two ergospirometry tests, with an interval of 6 months of normalization of thyroid-stimulating hormone levels (levothyroxine replacement group) vs. a simple observation. Twenty 30-57 year-old women with no thyroid dysfunction were also evaluated. Results suggest that there were no relevant differences in cardiopulmonary recovery for either group at baseline or after follow-up. In the sample studied, levothyroxine replacement improved exercise cardiopulmonary reserve, but no modification was found in recovery performance after exercise during this period of analysis.

The use, or misuse of steroids are the subject of two previously discussed studies. Carmo et al.[9] evaluated the effects of aerobic training (swimming) and anabolic steroids on cardiac structure and function in rats and claim that anabolic steroid treatment associated with swimming induces improper concentric hypertrophy, mainly by the increase in interstitial collagen, which can lead to loss of diastolic function. Bruder-Nascimento et al.[16] investigated the effects of the androgenic anabolic steroid nandrolone, exercise (swimming) and stress (2 hr. immobilization) on the vascular responses of rats and found that physical exercise determine similar vascular adaptive response involving distinct mechanisms as indicated by the observation that only the physical exercise-induced adaptive response was abolished by nandrolone.

A single paper deals with exercise during development. Hackney et al.[55] evaluated hormonal responses to incremental-stage exercise test to exhaustion in adolescents. Adolescents were tested at 16 years of age in Tanner Stage 4 and at 17 years of age in Tanner Stage 5. Adults were tested at age 21 years and served as controls. Blood samples were taken at rest, at the end of each exercise stage. Cortisol increased with each exercise stage and testosterone increased through Tanner stages through adulthood. Growth hormone increased in response to exercise in all groups, but less for Tanner stage 5 and adults. Differences in testosterone and growth hormone reflect the differing maturation levels of the endocrine system between Tanner Stages. Tanner stage 5 adolescents are more similar to young adults in hormonal responses to exercise than the Tanner stage 4 adolescents.

Psychiatry: The importance of exercise in the management of various psychiatric alterations is discussed in four articles. Vasques et al.[56] assessed the acute effect of physical exercise (treadmill) on the cognitive function of 10 depressed elderly patients in a dual-task experiment (Digit Span Test – Forward and Backward) and a Stroop Color-Word Test) performed before, immediately after, and 15 minutes after walking on a treadmill for 30 minutes. The Digit Span Test did not change between the pre- vs. post-exercise sessions but the Stroop Color-Word Test improved, a positive effect of exercise on cognition. They conclude that the dual-task may be a safe and useful tool for assessing cognitive function. Scolandes et al.[57] endeavored to identify changes in depressive symptoms, quality of life, and cortical asymmetry produced by aerobic activity in 20 elderly subjects (14 female) with a diagnosis of major depressive disorder. After 1 year the control group showed a decrease in cortical activity in the right hemisphere (increase of alpha power), not seen in the exercise group. Exercised patients showed significant decreases of depressive symptoms, accompanied by improved treatment response and remission rate. The study provides support for the effect of aerobic training on alpha activity and on depressive symptoms in elderly patients. Exercise facilitates the treatment of depressive elderly adults, leading to clinical and physical improvement and protecting against a decrease in cortical activity. Stella et al.[58] analyzed the effects of aerobic exercise (flexibility, strength, and agility, and functional balance exercises conducted over six months for 60 minutes three times per week) on the neuropsychiatric symptoms of 32 Alzheimer's disease patients and on the caregivers' burden. Patients were divided into two groups: 16 performed exercise and 16 controls remained sedentary. Psychopathological features of patients were evaluated with the Neuropsychiatric Inventory and Cornell Scale for Depression in Dementia. Caregivers were evaluated using the Neuropsychiatric Inventory-Distress and Burden Interview. Authors claim that aerobic exercise was associated with a reduction in the neuropsychiatric symptoms and contributed to attenuate the caregivers' burden. Christofoletti et al.[59] assessed the effects of physical activity on neuropsychiatric disturbances in 59 demented patients and on the mental burden of their caregivers. Patients were divided into three groups according to their diagnosis and level of physical activity. Data were assessed through a semi-structured interview. Patients with Alzheimer's or vascular dementia who engaged in physical activity had fewer neuropsychiatric symptoms than those who did not. When compared to the control group, the caregivers of patients with vascular dementia who engaged in physical activity had a reduced burden. The regular practice of physical activity seems to contribute to a reduction in neuropsychiatric symptoms in dementia patients and to attenuate the burden of the caregivers of those patients. Caldirola et al.[60] investigated the possible influence of psychological variables on cardiorespiratory responses and perceived exertion of 10 patients with Panic Disorder during a submaximal exercise test (treadmill slope at 4 km/h) to reach 65% of their maximum heart rate. Compared to controls, patients reached the target heart rate and the ventilatory threshold earlier, had lower oxygen consumption,

and lower within-subject standard deviations of HR. Exertion was higher, and there was a significant correlation between breathing frequency, tidal volume and HR. No significant associations were found between cardiorespiratory response, perceived exertion, and psychological variables in these patients. Although they presented poor cardiorespiratory fitness and were required to spend more effort during physical exercise, this did not appear to be related to the psychological variables considered.

Geriatrics: The importance of exercise in aging population is well established but a few papers in this digression cover the problem in specific and original manners. Reichert et al.[61] endeavored to determine the existence of a relationship between physical activity and depressive symptoms in community--dwelling elders and found that physical activity is inversely related to depressive symptoms in men, but not in women. Kanegusuku et al.[62] endeavored to determine whether strength training (constant movement velocity) or power training (concentric phase performed as fast as possible) can blunt the increase in cardiovascular load during an aerobic stimulus in older adults (63.9±0.7 years) submitted to power training. They found that neither strength nor power training blunted submaximal or maximal pressure, rate or the pressure rate product increases during the maximal exercise test, showing that they did not reduce cardiovascular stress during aerobic tasks. Bocalini et al.[63] evaluated the effects of short-term exercise detraining on the functional fitness of older women after a 12-week water--based exercise program given to healthy older women in comparison to an aged-matched group of untrained women. Their results confirm that 12 weeks of training improves the functional fitness parameters and quality of life of older women. However, after a short detraining period of 4-6 weeks, the neuromuscular parameters and the quality of life score returns to baseline or untrained subject levels. In a previously discussed paper, Brito et al.[17] evaluated the late effects of malnutrition during lactation and of moderate aerobic training on the luminal diameter and the tunica media area of the left common carotid artery, horizontal aorta and thoracic aorta of rats in the aging process. They conclude that malnutrition induced partial changes in the horizontal aorta wall, whereas physical training promoted changes in the tunica media area of the left common carotid artery and luminal diameter of the thoracic aorta.

Nociception: The exercise-nociception interaction is discussed in one human and three animal model studies. Aliberti et al.[64] investigated the influence of Patellofemoral Pain Syndrome on plantar pressure distribution during the foot rollover process of the gait in 57 young adults (22 with Patellofemoral Pain Syndrome vs. 35 control subjects). They conclude that the syndrome is related to a foot rollover pattern that is medially directed at the rear foot during initial heel contact and laterally directed at the forefoot during propulsion. They claim that the detected alterations in the foot rollover process during gait may be used to develop clinical interventions using insoles, taping and therapeutic exercise to rehabilitate this dysfunction. Bertolini et al.[65] evaluated and compared the effects of low-level laser therapy vs. swimming training in a joint nociception model on Wistar rats. divided into (i) non-treated animals submitted to nociception; (ii) nociception + laser therapy (iii) nociception and swimming for 10 minutes in water at 30-32^{o} C; (iv) nociception plus swimming and laser. The analyses showed that laser therapy alone was the only group to present the restoration values. Swimming alone was the only group which did not show any reduction. Authors infer laser therapy had some analgesic effects, while swimming increased pain, which was partially reversed by the simultaneous use of laser. Galdino et al.[66] investigated the influence of different resistance exercise protocols on the nociceptive threshold of female Wistar rats performing a weight-lifting exercise model. Trained rats exhibited antinociception up to day 45 of the 12-week training period. A significant increase in the nociceptive threshold was produced immediately after exercise, decreasing to 15% after 15 min, when the acute exercise protocol was used. Naloxone reversed this effect. They conclude that the acute resistance exercise protocol was effective in producing antinociception for 15 min and that the antinociceptive effect is mediated by the activation of opioid receptors. As discussed previously, Rossi et al.[51] investigated the effects of chronic (eight weeks) low-to moderate-intensity swimming training on thermal pain sensitivity in 51 streptozotocin-induced diabetic Wistar female rats. And conclude that low-to-moderate swimming training for a long duration reduces thermal hyperalgesia during a pain sensitivity test in streptozotocin-induced diabetic female rats.

Pediatrics: Four articles cover exercise in relation to pediatric clinics. Lopi et al.[67] determined chronological and corrected ages at acquisition of motor abilities up to unaided walking in 13 very low weight preterms and up to what point it is necessary to use corrected age. Preterms achieved head control at 3 months, sat unaided at 7 months and walked at 13 months corrected age, corresponding to the 4th, 9th and 15th months of chronological age. Preterms who were small for their gestational age acquired motor abilities later, but still within expected limits. Very low weight preterms, free from neurosensory disorders, acquired their motor abilities within the ranges expected for their corrected ages, which should be used until unaided walking is achieved. Two papers have been previously discussed. Wicher et al.[45] investigated the benefits of a swimming program in asthmatic schoolchildren and adolescents and find that moderate persistent atopic asthma subjected to a swim training program led to a decrease in bronchial hyper responsiveness. They also showed improvement in elastic recoil of the chest wall. Mattiello et al.[43] assessed functional capacity during exercise in 20 children and adolescents with post-infectious bronchiolitis obliterans and suggest that due to its greater feasibility, 6-minute walk test could be an alternative where cardiopulmonary exercise testing is not available. In a murine model, Nery et al.[68] assessed body growth and feed efficiency in Wistar rats during lactation in reduced litters (4 males/litter – overfed) or normal litters (10 animals/litter – eutrophic) litters. When weaned rats were divided into sedentary and exercised (swimming), forming thus four groups: overfed sedentary or trained, eutrophic sedentary or overtrained. Overfed rats had higher weight gain during lactation, but slower after weaning. After training, eutrophic trained rats had lower weight than eutrophic sedentary, while no difference occurred between overfed trained or sedentary animals. In periadolescence, overfed rats showed lower food intake, but with no differences in adulthood. They conclude that reduced litter during lactation did not affect body weight or food intake persistently, whereas swimming was effective in reducing weight gain in control animals, but not in animals from reduced litters.

Rheumatology: Three papers looked at osteoarthritis. Costa et al.[69] evaluated the difference in isokinetic strength of hip muscles between 25 patients with unilateral, 25 with bilateral knee osteoarthritis and 50 matched healthy controls, in order to establish the correlation between this isokinetic strength, pain and function in osteoarthritic patients They found a lower peak torque of the hip in patients vs. controls for all the studied movements. Strong correlations were found between peak torque, visual analog scale and function. They suggest that strengthening the muscles surrounding the hip joint may help to decrease pain in people with knee OA. Ciolac et al.[70] analyzed muscle strength and exercise intensity adaptation to resistance training in older women with one osteoarthritic knee and one knee with total arthroplasty. Results were compared to older women, without symptomatic osteoarthritis, and with 8 healthy young women. At baseline, osteoarthritic subjects displayed lower muscle strength than those in the control groups. Among osteoarthritic subjects, baseline muscle strength was lower in the osteoarthritic leg than in the total arthroplasty leg. Muscle strength improved significantly during follow-up in all groups; however, greater increases were observed in the osteoarthritic leg than in the total knee arthroplasty leg and reduced the interleg difference. It also resulted in similar post-training muscle strength between osteoarthritic and healthy senior ladies. Carvalho et al.[71] assessed the efficacy of a guidance manual with instructions on how to perform the exercises at home for 38 patients with osteoarthritis of the knee in relation to pain, range of movement, muscle strength and function, active goniometry, manual strength test and function. They were evaluated for pain, range of movement, muscle strength and function. The study showed that guidance is useful: when exercises were performed at home without supervision, the use of the printed manual for guidance made them beneficial for osteoarthritis of the knee.

Gynecology: Contributes three papers to the exercise collection. Ciolac et al.[72] compared the heart rate response to exercise and the exercise-induced improvements in muscle strength, cardiorespiratory fitness and heart rate response between 79 normal-weight *vs*. 76 overweight/obese postmenopausal sedentary women. Their 1-repetition maximum strength cardiorespiratory fitness and heart rate response to a graded exercise test was compared before and after 12 months. Overweight/obese women displayed decreased muscle strengths, decreased cardiorespiratory fitness, and lower peak and reserve heart rates compared to normal-weight women. After follow-up, both groups improved their muscle strength. However, only normal-weight women improved their cardiorespiratory fitness and recovery heart rate. Thus, exercise-induced improvements in cardiorespiratory fitness and heart rate response to exercise may be impaired in overweight/obese postmenopausal women. Barbalho et al.[73] tested the effects of continuous and intermittent exercises (maternal swimming) on the biochemical profile of pregnant Wistar rats and the effects of these exercises on the fetal body weight. They found that continuous and intermittent exercise during pregnancy decreases fetus body weight. As previously discussed, Nery et al.[68] assessed body growth and feed efficiency in Wistar rats during lactation in reduced litters (4 males/litter – overfed) or normal litters (10 animals/litter – eutrophic) litters. And found that reduced litter during lactation did not affect body weight or food intake persistently, whereas swimming was effective in reducing weight gain in control animals, but not in animals from reduced litters.

Immunology: Ferreira et al.[74] analyzed the effects of exhausting long-duration physical exercise (swimming) sessions of different durations and intensities on the number and phagocytic capacity of macrophages and neutrophils in Wistar sedentary rats divided into untreated (macrophage study) or oyster glycogen-treated rats (neutrophil study). In each group, rats were further subdivided into unexercised controls, unadapted low or moderate-intensity exercise, adapted low or moderate-intensity exercise, all performed to exhaustion. Peritoneal macrophages decreased after unadapted exercise but increased after pre-adapted low-intensity exercise, with no changes after the moderate-intensity exercise. Phagocytic capacity increased by more than 80% in all exercise groups. Peritoneal neutrophils decreased after unadapted and pre-adapted low-intensity exercise but increased after unadapted and pre-adapted moderate exercise. Neutrophil phagocytic capacity decreased after unadapted moderate exercise but increased after corresponding pre-adapted sessions. There changes in the low-intensity exercise groups. Thus, neutrophils and macrophages of sedentary rats respond differently to exercise-induced stress and that adaptation reduces exercise-induced stress on the immune system. Nakalta et al.[26] as already reported,determined whether cognitive awareness of carbohydrate beverage consumption affects exercise-induced lymphocyte apoptosis, regardless of actual carbohydrate intake and claim that neither carbohydrate nor placebo supplementation altered the typical lymphocyte apoptotic response following exercise. While carbohydrate supplementation has an immune-boosting effect during exercise, it appears that this influence does not extend to the mechanisms that govern exercise-induced lymphocyte cell death.

Tobacco: Two previously discussed papers evaluate the relation of exercise and smoking: Silva et al. (50) evaluated the effect of smoking and associated moderate physical activity on the insulin sensitivity in the heart by GLUT4 gene expression and found that smoking reduces insulin sensitivity and the cardiac ability in uptaking glucose, which can be reversed by moderate physical exercise. Camargo-Filho et al.[38] analyzed the adaptations of the skeletal musculature to the interaction between physical activity practice and cigarette smoke exposure and conclude that the interaction between cigarette smoke exposure and physical activity during 15 days accentuated the histological changes in the soleus muscle, causing an alteration in the enzymatic activity and increase in the fiber diameter.

Three papers unrelated to any of the previous topics close this review. Ackel-D'Elia et al.[75] evaluated the occurrence of the well-known predisposing factors and signs and symptoms usually associated with either overreaching or overtraining syndrome in physical fitness centers in São Paulo City, Brazil through a questionnaire consisting of 13 question groups pertaining to either predisposing factors or signs and symptoms (8-13) given to 413 subjects. Hematological parameters, creatine kinase activity, cortisol, total testosterone and free testosterone concentrations were within the normal ranges for the majority of the volunteers selected for this analysis. According to the questionnaire score analysis, no predisposing factors or signs and symptoms usually associated with either overreaching or overtraining were detected. Lacaze et al.[76] evaluated musculoskeletal discomfort and mental and physical fatigue in 64 call-center workers of an airline company before and after a supervised exercise program compared with rest breaks during

the work shift, 32 being placed in a 10-min daily exercise session for 2 months, while 32 controls took a 10-min rest break during the same period. Each subject was evaluated once a week by means of the Corlett-Bishop body map with a visual analog discomfort scale and the Chalder Fatigue questionnaire. Results appear to demonstrate that appropriately designed and supervised exercise programs may be more efficient than rest breaks in decreasing discomfort and fatigue levels in call-center operators. Correia et al.[77] measured the levels of brain-derived neurotrophic factor and concentric strengths of knee (large) and elbow (small) flexor and extensor muscles on two separate days in 16 healthy subjects before and after exercise. Results demonstrate that acute strength exercise does not induce significant alterations in the levels of brain-derived neurotrophic factor plasma concentrations in healthy individuals. Because these levels may be affected by various factors, such as exercise, they claim that their findings suggest that the type of exercise program may be a decisive factor in altering peripheral brain-derived neurotrophic factor.

CONCLUSIONS

In conclusion it clearly appears that the general subject of exercise has been the subject of a considerable amount of recent research in Brazil, that a very large part of this research has found its way into Brazilian periodicals, and that a number of controversial issues have been examined by different authors. As we see it this is a facet of the quality of recent Brazilian research and points to a positive future.

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