Machine Translated by Google

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

The impact of personalized physical training on cardiovascular health: a narrative review of advanced approaches in rehabilitation and biomechanics.

The impact of personalized physical training on cardiovascular health: a narrative review on advanced approaches in rehabilitation and biomechanics

The impact of personalized physical training on cardiovascular health: a narrative review on advanced approaches in rehabilitation and biomechanics

Ricardo Ratão

holds a degree in Physical Education (1999);
Specialist in Physical Conditioning and Cardiac Rehabilitation.
CEO and consultant in sports management.

SUMMARY:

This study consists of a narrative review, in the form of a theoretical essay, that investigates the physiological adaptations resulting from individualized physical training, with a primary focus on cardiac rehabilitation and the preservation of mobility. The analysis delves into the biological mechanisms by which controlled exercise prescription induces myocardial remodeling and optimizes endothelial function. The work discusses the clinical responsibility of physical education professionals in developing safe protocols for populations with comorbidities. The reviewed literature indicates that training periodization acts to mitigate chronic functional decline associated with senescence and inactivity.

It is concluded that supervised physical exercise is consolidating itself as one of the most relevant non-pharmacological therapeutic interventions in the sports medicine literature, which demands...
Methodological rigor to prove its effectiveness in prophylaxis and rehabilitation.
Keywords: Cardiac Rehabilitation; Sports Physiology; Personalized Training; Biomechanics; Exercise Prescription.

ABSTRACT:

This study consists of a narrative review in the format of a theoretical essay that investigates the physiological adaptations resulting from individualized physical training, with a primary focus on cardiac rehabilitation and mobility preservation. The analysis deepens the biological mechanisms by which the controlled prescription of exercises induces myocardial remodeling and optimizes endothelial function. The paper discusses the clinical responsibility of the physical education professional in structuring safe protocols for populations with comorbidities.

The reviewed literature indicates that training periodization mitigates chronic functional decline associated with senescence and inactivity. It is concluded that supervised physical exercise consolidates itself as one of the most relevant non-pharmacological therapeutic interventions in sports medical literature, requiring methodological rigor for its prophylactic and rehabilitative efficacy.

Keywords: Cardiac Rehabilitation; Sports Physiology; Personalized Training; Biomechanics; Exercise Prescription.

1. INTRODUCTION

Sedentary lifestyles, coupled with an aging population, pose a logistical challenge and

substantial financial support to public and supplementary health systems (WHO, 2018). A

Physical inactivity is widely recognized in the literature as one of the main factors of

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google
RCMOS – Multidisciplinary Scientific Journal The Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

Modifiable risk factors for the development of metabolic syndromes and disorders
acute cardiovascular events. Given this structural scenario, supervised physical exercise and
Properly dosed, it has been investigated as a primary tool for protection.
Systemic system of the human organism. Historically, conservative approaches in medicine
They advocated prolonged bed rest as the standard treatment for cardiac pathologies and
degenerative. However, advances in sports medicine and cardiology have shown that...
The body possesses a remarkable capacity for adaptation to mechanical and metabolic stressors, since
that the stimulus is properly planned and monitored (Carvalho et al., 2020). The insertion of
Specialist professionals in exercise physiology for outpatient clinical follow-up.
altered recovery prognoses by transitioning physical activity from a recreational resource.
to an adjuvant clinical protocol. The objective of this narrative review, structured as an essay
Theoretically, it aims to consolidate the scientific foundations that underpin personalized training.
as the central axis of cardiac rehabilitation and functional prevention. The premise investigated
It argues that methodological generalization can limit therapeutic outcomes, and that...
Detailed mapping of individual physiological variables is the best way
based on the principles of promoting lasting and safe biological adaptations.

2. RESEARCH METHODOLOGY

The methodological scope of this article was constructed from a narrative review of
literature, supported by analysis of cardiology and sports medicine guidelines (ACSM,
2022; Carvalho et al., 2020), associated with the classic literature in physiology and training (Fleck
& Kraemer, 2017; McArdle et al., 2019). The survey focused on the intersection between exercise
Physical factors, the cardiovascular system, and biomechanical adaptations. In addition to the reference framework
Theoretically, the article adopts the structure of a reflective essay to discuss the practical application of these principles.
concepts. Observations on the effectiveness of rehabilitation and conditioning protocols,
The practices described throughout the text stem from a qualitative analysis of professional practices in centers.
training. This approach seeks to establish a critical link between knowledge
physiological stricto sensu and its applicability in prescription routines, aiming at the promotion of
health and stabilization of hemodynamic markers.

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google
RCMOS – Multidisciplinary Scientific Journal The Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

3. PHYSIOLOGY AND SYSTEMIC STRUCTURAL DECLINE

The advancement of biological age is associated with molecular processes that affect homeostasis.
physiological changes in the body. Functional decline affects the cardiovascular system in a way that...
particularly, often characterized by stiffening of the arterial walls and by
A tendency toward compensatory concentric ventricular hypertrophy. Reduced elasticity.
Peripheral vascular disease demands greater contractile effort from the myocardium to maintain perfusion.
tissue, which predisposes the individual to progressive increases in systemic blood pressure.
(McArdle et al., 2019). These morphological modifications affect the maximum capacity of
Uptake, transport, and utilization of cellular oxygen (VO2 max). Reduction of oxygen flow.
Maximum cardiac output and the gradual loss of myocardial tissue compliance impair the
Diastolic relaxation. Consequently, the oxygenation of skeletal muscles is
compromised during exercise, which contributes to early episodes of organic fatigue.
and reduced tolerance to exertion. Concomitantly with the cardiovascular changes, the system
neuromuscular system goes through processes of sarcopenia (loss of muscle mass) and dynapenia (loss of
(of muscle strength). Selective atrophy of fast-twitch muscle fibers (type) is observed.
II), which reduces the ability to generate power and compromises dynamic and postural balance.
(Fleck & Kraemer, 2017). This reduction in skeletal muscle affects the metabolic rate.
basal metabolic rate and alters body composition, favoring the accumulation of visceral adipose tissue.
Physical inactivity acts as a catalyst for these changes. Without mechanical stimuli and
In metabolic disorders, the body exhibits reduced efficiency in protein synthesis and biogenesis.
mitochondrial. The use of exercise physiology by the professional contributes to the development of
Interventions aimed at mitigating this functional decline. The application of physical stimuli.
adequately activates enzymatic cascades that promote cellular respiration and restore
partially organic resilience.

4. BIOMECHANICS AND ADAPTIVE TRAINING PRINCIPLES

Developing exercise protocols requires the application of biological principles.
training and biomechanics. The principle of specificity indicates that adaptations
Morphological and neuromuscular changes are strictly linked to the nature of the stimulus applied.
(ACSM, 2022). In a clinical context, this suggests that exercises should approximate the
Motor patterns necessary for the practitioner's autonomy in their daily life activities. A

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google
RCMOS – Multidisciplinary Scientific Journal The Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

Biological individuality is a principle that advises against the use of standardized methodologies. In populations with anatomical or physiological limitations, kinematic assessment is essential. to identify muscle imbalances, postural compensations, and joint weaknesses. The Adjusting the range of motion and controlling the mechanical load act as factors of Protection of capsuloligamentous and tendinous structures. The methodological progression is guided based on the principle of progressive overload. Acute changes in volume or intensity. They can exceed the tissue regeneration capacity, generating inflammatory responses. exacerbated instead of positive adaptation. The careful oscillation of loads, associated with Monitoring the subjective perception of effort prevents stagnation and promotes... Supercompensation in a controlled manner. Strength training, specifically, plays a role. a protective role in the musculoskeletal structure. The tension generated by resisted contraction It induces the piezoelectric effect, favoring the maintenance or increase of mineral density. In addition, strengthening the stabilizing muscles (core) optimizes bone distribution. of the forces on the spine. The fluidity and technical control of movement, especially with Emphasis on the eccentric and concentric phases, overriding absolute load as the primary metric. of success in motor recruitment (Fleck & Kraemer, 2017).

5. Cardiac Rehabilitation and Endothelial Remodeling

In the context of cardiovascular rehabilitation, supervised physical exercise promotes changes. Hemodynamic changes are widely documented. Shear stress induced. Regular aerobic training increases the production and bioavailability of nitric oxide. endothelial. This endogenous vasodilator acts to reduce peripheral vascular resistance. assisting in the clinical management of arterial hypertension (Carvalho et al., 2020). In addition to the function In endothelial cells, the systematized movement has a positive effect on the lipid and glycemic profile. Muscle activity increases the oxidation of free fatty acids and may contribute to an increase. of high-density lipoproteins (HDL). Trained skeletal muscle exhibits greater GLUT-4 receptor translocation, which optimizes glucose uptake and reduces Compensatory hyperinsulinemia, factors that delay the progression of complications. microvascular. For the safety of patients with coronary artery disease or hypertension, control of Intensity requires objective parameters, often based on tests. ergospirometric testing. Identifying ventilatory thresholds allows for the establishment of zones of Training that strengthens left ventricular contractility without inducing ischemia.

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

myocardial (ACSM, 2022). The autonomic modulation promoted by exercise increases muscle tone.
The parasympathetic system is at rest, which is associated with a lower risk of arrhythmias. Peripherally, the
Increased capillary density and mitochondrial biogenesis enhance tissue oxygen uptake.
(arteriovenous oxygen difference). This mechanism allows the patient to perform tasks
Daily submaximal movements with less need for abrupt increases in cardiac output, attenuating
The sensation of dyspnea associated with minor exertion reinforces the need for integration.
between medical cardiology and exercise physiology.

6. The Physical Education Teacher in Multidisciplinary and Clinical Intervention

The inclusion of physical education professionals in the clinical setting requires skills that...
transcend the conventional pedagogy of movement, demanding knowledge in
Biomedical sciences and pharmacology applied to exercise. Drug interactions.
(such as beta-blockers and diuretics) and the acute physiological responses to exercise require
Adjustments to the prescription are necessary because these drugs alter cardiac chronotropism and inotropism.
(ACSM, 2022), which may induce syncope or hypotension. Patient adherence to the protocol
It depends heavily on interprofessional communication and support. The physical education teacher
The clinician works by modulating the neurocognitive perception of an individual's ability, helping
overcoming kinesiophobia (fear of movement) often associated with diagnoses
recent cardiac or orthopedic procedures. The rigor in the scientific application is evident in the planning.
Periodized. The structuring of micro, meso, and macrocycles of training adjusts the dosage.
managing internal and external loads, preventing overtraining and minimizing acute risks.
Furthermore, working in clinical conditioning facilities requires absolute mastery.
of basic life support (BLS) protocols and the handling of external defibrillators.
automatic devices (AEDs), ensuring the stabilization of any incidents until the arrival of
advanced medical support.

7. Longitudinal Impacts on Quality of Life

Analysis of the literature on the long-term effects of exercise shows an improvement.
Systemic impact on health-related quality of life. The main objective of clinical prescription.
It transcends isolated morphofunctional alterations, focusing on restoring the autonomy of...
The practitioner. Improved mobility and musculoskeletal strength restore the individual to

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google
RCMOS – Multidisciplinary Scientific Journal The Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

The ability to manage your daily and work activities with less dependence on others.
From a psychosocial perspective, regular physical activity has effects associated with the regulation of
Humor. The modulation of neurotransmitters and the regulation of the hypothalamic-pituitary-adrenal axis.
They help to lower baseline cortisol levels, contributing to stress management.
chronic and for the mitigation of mild to moderate depressive symptoms. Additionally, the
Chronic responses to training influence sleep architecture. It is observed that practitioners
Regular sleep patterns show improved sleep efficiency and more time spent in slow-wave sleep stages.
fundamental for the release of building hormones and for the restoration of the matrix
cellular energy (McArdle et al., 2019). Finally, exercise acts as a modulator of
Low-grade systemic inflammation. Strengthening the periarticular muscles alleviates the
compressive forces on cartilage, aiding in the conservative management of conditions.
rheumatological and osteoarthritis conditions, which directly impacts the reduction of pain and...
promoting active aging.

FINAL CONSIDERATIONS

Analysis of the physiology of exertion and musculoskeletal adaptations reinforces the magnitude
Theoretical evidence regarding physical training as a structured intervention in human health.
They indicate that degenerative processes are associated with vascular inactivity and senescence.
These effects can be mitigated through the systematic application of mechanical and metabolic stimuli.
controlled. Exercise, when prescribed based on clinical and methodological rigor, constitutes
An essential pillar of preventive and adjuvant medicine. Individualized approaches, guided by...
In kinematic assessments and cardiopulmonary exercise tests, they demonstrate conceptual superiority.
Regarding generalist prescription models. The manipulation of training variables.
It ensures safe adaptive responses, acting directly on endothelial remodeling, in
Increased vascular compliance and optimization of peripheral motor recruitment. So that
For this therapeutic potential to be fully realized, the physical educator must assume a
Interdisciplinary clinical approach. The integration between movement science, cardiology and...
Rehabilitation guidelines ensure not only the improvement of physiological parameters and
biochemical, but also the tangible promotion of autonomy, functional capacity and
quality of life for vulnerable populations.

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Machine Translated by Google

Year V, v.1 2024 | Submission: 06/12/2024 | Accepted: 09/12/2024 | Publication: 12/12/2024

REFERENCES

AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM). **ACSM Guidelines for Exercise Testing and Prescription.** 11th ed. Rio de Janeiro: Guanabara Koogan, 2022.

CARVALHO, T. et al. Brazilian Guideline for Cardiovascular Rehabilitation – 2020. **Arquivos Brasileiros de Cardiologia,** São Paulo, v. 114, n. 5, p. 943–987, 2020.

FLECK, SJ; KRAEMER, WJ **Fundamentals of Strength Training.** 4th ed.
Porto Alegre: Artmed, 2017.

MCARDLE, WD; KATCH, FI; KATCH, VL. **Exercise Physiology: Nutrition, Energy, and Human Performance.** 8th ed. Rio de Janeiro: Guanabara Koogan, 2019.

WORLD HEALTH ORGANIZATION (WHO). **Global action plan on physical activity 2018–2030: more active people for a healthier world.** Geneva: WHO, 2018.

This article is published in open access under the Creative Commons Attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.