LIETUVOS SPORTO MEDICINOS FEDERACIJA

LIETUVOS SVEIKATOS MOKSLŲ UNIVERSITETAS

11TH BALTIC SPORTS MEDICINE CONGRESS

BRIDGING THE GAP BETWEEN SCIENCE AND PRACTICE

ABSTRACT BOOK

2023 09 22-23

KAUNAS, LITHUANIA

BALTIC SPORTS MEDICINE CONGRESS XI

BRIDGING THE GAP BETWEEN SCIENCE AND PRACTICE

2023 09 22-23 | KAUNAS, LITHUANIA

ORGANIZERS

Lithuanian Federation of Sports Medicine

and

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

Department of Sports Medicine

CONFERENCE EXHIBITORS:

Magnesium Diasporal · K-LASER · MEDA Medicinos ir SPA įranga · TEIDA

SCIENTIFIC COMMITTEE AND REVIEWERS

Prof. Dr. Kristina Berškienė
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Prof. Dr. Laimonas Šiupšinskas
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Assoc. Prof. Dr. Algė Daunoravičienė
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Assoc. Prof. Dr. Agnė Slapšinskaitė-Dackevičienė
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Assoc. Prof. Dr. Vilma Tamulionytė
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Assoc. Prof. Dr. Renata Žumbakytė-Šermukšnienė
(Lithuanian University of Health Sciences, Department of Sports Medicine)

Dr. Sandra Rozenštoka (Latvia)

Assoc. prof. dr. Eve Unt (Estonia)

Abstracts included in the „Book of Abstracts“ were reviewed by independent scientific reviewers.

ISBN 978-9955-15-809-7

THE ROLE OF LABORATORY AND IN-FIELD BASED PERFORMANCE METRICS IN PREDICTING COMPETITION OUTCOMES: A STUDY OF LITHUANIAN ELITE AND AMATEUR CYCLISTS

Leonardo Cesanelli[1], Juan Antonio Fernandez Lopez[1]

[1]Institute of Sport Science and Innovations, Lithuanian Sports University, Kaunas, Lithuania.

Introduction: To effectively monitor and optimize training progress, as well as guide athletes toward peak performance in road cycling competitions, the assessment of physiological and performance-related variables through testing is crucial (1). Among these variables, certain indicators of endurance have been recognized as critical for cycling performance (2). However, the diverse range of cycling performance tests poses a challenge for athletes, coaches, and practitioners in selecting the most suitable ones to predict competition outcomes (3–5). The present study sought to assess the predictive capacity of various performance metrics on the competition results of both elite and amateur Lithuanian cyclists.

Research methods and organization: The research protocol adhered to the Declaration of Helsinki and was approved by the Ethics Committee of the Lithuanian Sports University: (MNL-SVA (M)-2023-578). A total of sixteen male elite and seventeen male amateur cyclists participated in the study voluntarily, having provided their informed consent. The participants completed a series of tests, including an incremental laboratory ramp test with gas exchange analysis and an in-field functional threshold power (FTP) test on separate days (1). Subsequently, performance data and results were extracted from a national competition in which all the athletes took part. Pearson's correlations were employed to assess the associations between the performance metrics derived from laboratory and in-field tests and the competition results. To develop a predictive model for competition outcomes, stepwise multiple regression analysis was utilized, integrating the performance metrics from the tests. Additionally, differences between amateur and elite cyclists were analyzed using an independent t-test. Statistical significance was set at $p<0.05$.

Results: Among the different performance indicators analyzed, maximal oxygen consumption ($\dot{V}O2max$) stood out as the primary explanatory variable (R2adj: 0.76) for competition results, followed by FTP (R2adj: 0.58), maximal aerobic power (R2adj: 0.56), and peak power output (R2adj: 0.53) ($p < 0.05$). No significant differences were observed in the predictive power of these variables for competition performance when individually analyzed between elite and amateur cyclists ($p > 0.05$). However, elite cyclists demonstrated an improved physiological profile and overall competition performance for the majority of the variables considered ($p < 0.05$).

Conclusions: The present study highlights the significance of specific performance metrics in predicting competition performance for both elite and amateur Lithuanian cyclists. Characterizing key performance metrics able to predict competition performance can emphasize: the disparities between elite and amateur Lithuanian cyclists and even international level cyclists; the crucial markers to monitor throughout the season to anticipate performance changes and predict potential competition outcomes.

References

1. Phillips KE, Hopkins WG. Determinants of Cycling Performance: a Review of the Dimensions and Features Regulating Performance in Elite Cycling Competitions. Sports Med Open. 2020 Jun 3;6.

2. Joyner MJ, Coyle EF. Endurance exercise performance: the physiology of champions. J Physiol. 2008 Jan 1;586(Pt 1):35–44.

3. Hirsch A, Bieleke M, Bertschinger R, Schüler J, Wolff W. Struggles and strategies in anaerobic and aerobic cycling tests: A mixed-method approach with a focus on tailored self-regulation strategies. PLoS One. 2021 Oct 27;16(10):e0259088.

4. Schneeweiss P, Schellhorn P, Haigis D, Niess A, Martus P, Krauss I. Predictive Ability of a Laboratory Performance Test in Mountain Bike Cross-country Olympic Athletes. Int J Sports Med. 2019 May;40(6):397–403.

5. Sørensen A, Aune TK, Rangul V, Dalen T. The Validity of Functional Threshold Power and Maximal Oxygen Uptake for Cycling Performance in Moderately Trained Cyclists. Sports (Basel). 2019 Oct 1;7(10):217.

THE EFFECTS OF A SPECIALIZED EXERCISE PROGRAM ON FLEXIBILITY, EXPLOSIVE STRENGTH, AND ANGER EXPRESSION IN ADOLESCENTS PRACTICING TRADITIONAL KARATE

Eligijus Šinkūnas, Ernesta Aukštuolytė-Bačienė, Vilma Tamulionytė

Lithuanian University of Health Sciences, Department of Sports Medicine, Lithuania

INTRODUCTION

Motor skills' development has a really important role in daily life, and it should encourage youngsters to engage more in physical activity to improve their physical skills [1]. One such activity is the Japanese martial art of karate, which requires a high level of motor and functional skills: strength, flexibility, balance, coordination, and agility [2]. While participating in sports athletes can feel some emotions, such as pride, anxiety, and anger. One of the most common states in competitive sports is anger [3]. Although it is typically regarded as bad, it occasionally can serve as competition motivation [4, 5]. The aim of this research is to assess physical characteristics and anger expression changes in adolescents attending karate.

RESEARCH METHODS AND ORGANIZATION

The research was approved by the Bioethics Center. Participants: 30 adolescents attending traditional karate. They had to meet several inclusion criteria: age between 11 and 16 years; male; attending traditional karate for at least one year, no less than twice a week for 60 minutes; not attending any other sports classes or training sessions; not having suffered any injuries in the last six months (such as muscle and ligament tears, bone fractures, etc.), and not having been diagnosed with a certain medical condition (systemic lupus erythematosus, juvenile idiopathic arthritis, myasthenia gravis, etc.) that could affect the results. The participants were grouped according to their experience level (karate kyu belts) – the beginners' group (n=14, age range 11-13 years) – white, yellow, and orange belts, and the advanced group (n=16, age range 12-16 years) – green, blue, and brown belts. The content of the karate session was the same in both groups except for the karate technique learning part which was different according to the experience level of participants. After the first examination, the exercise programme was designed based on the results. The programme was applied for 5 months and was followed by a second examination. Age was statistically different between groups ($U=9$; $p<0.001$). All participants filled out the questionnaire survey. Participants' anger control was assessed with an Anger expression scale for children (the greater score indicated better anger control). Flexibility was assessed with the Sit-And-Reach test and explosive muscle strength – with the performance test. Data statistical analysis was performed using IBM SPSS 27.0 Statistics. Non-parametric Mann-Whitney and Wilcoxon criteria were used. Data are presented as median (minimum value - maximum value; mean). Differences with $p<0.05$ were considered statistically significant.

RESULTS:

At the beginning of the study, there was a significant difference in flexibility between the groups (U=4; p<0.001). At the start beginners' flexibility was 23.25 (20.8-28.20; 23.5) cm and at the follow-up, it was 25.8 (23.2-29.1; 25.6) cm. Flexibility significantly improved (Z=-3.297; p<0.001). At the beginning, advanced group flexibility was 31.8 (25.3-35.5; 31) cm and at the follow-up, it was 33.5 (26.4-37.9; 32.9) cm. In the advanced group flexibility also significantly improved (Z=-3.518; p<0.001). At the end of the study flexibility between the two groups was still significantly different (U=5; p<0.001). At the beginning of the study, there was a significant difference in explosive strength between the groups (U=4; p<0.001). Beginners' explosive strength was 183.8 (172.2-208.4; 187.6) cm at the beginning and 192 (181.2-212.6; 195.2) cm at follow-up. Explosive strength significantly improved (Z=-3.296; p<0.001). At the beginning advanced group's explosive strength was 248.7 (200.3-264.7; 243.6) cm and at the follow-up, it was 252.9 (206.7-267.3; 248.11) cm. Explosive strength significantly improved (Z=-3.520; p<0.001). At the end of the study explosive strength between the groups, was significantly different (U=4; p<0.001). At the beginning of the study anger control between the groups was not significantly different (U=93.5; p=0.439). At the beginning of the study beginners' anger control result was 16.5 (13-21; 16.8) points, while in the advanced group – 17.5 (13-22; 17.6) points. And at the end of the study beginners' anger control result was 18 (15-23; 18.4) points, while in the advanced group – 19 (15-23; 19.1) points. Anger control significantly improved both in the beginners' group (Z= -3.407; p<0.001) also in the advanced group (Z= -3.611; p<0.001). At the end of the study, anger control was not statistically significantly different between the groups (U=98; p=0.558).

CONCLUSIONS

1. The advanced group of adolescents who attended karate demonstrated better flexibility and explosive strength both before and after participating in an exercise program. However, there was no noticeable difference in their ability to control their anger. 2. Both the beginners and advanced groups experienced improvements in flexibility, explosive strength, and anger control after completing a specialized exercise program.

REFERENCE LIST

1. Sutapa P, Pratama KW, Rosly MM, Ali SKS, Karakauki M. Improving Motor Skills in Early Childhood through Goal-Oriented Play Activity. Children (Basel). 2021;8(11):994.
2. Pal S, Yadav J, Kalra S, Sindhu B. Different Training Approaches in Karate-A Review. London Journal of Research in Humanities and Social Sciences. 2021;20(14):33-43.
3. Ruiz MC, Hanin YL. Perceived impact of anger on performance of skilled karate athletes. Psychol Sport Exerc. 2011;12(3):242–9.
4. Rydzik Ł. The comparison of the level of aggressiveness of Oyama Karate and mixed martial art fighters. Appl Sci (Basel). 2022;12(17):8446.
5. Ustun F, Tasgin E. Trait anger and anger expression styles in Muay Thai Athletes. J Educ Learn. 2020;9(1):258.

NON-TRAUMATIC COMPARTMENT SYNDROME: UNVEILING ITS SIGNIFICANCE IN SPORTS MEDICINE AND TOXICOLOGY

Robertas Badaras MD PhD, Republican Vilnius University Hospital
Linas Zdanavičius MD, Vilnius University

Understanding the types of Compartment Syndrome is crucial for prevention and efficient treatment of this complex phenomenon. Compartment syndrome, a severe and sometimes life-threatening condition, arises when increased pressure within one of the body's compartments, usually the arms or legs, limits blood flow. When blood flow is restricted, tissues are deprived of oxygen, leading to cellular damage or death. While the overview provided touched upon the causes of compartment syndrome, it is essential to categorize these causes to understand the varied nature of their origins better.

1. Sports-Related Muscle Strain Induced Compartment Syndrome

Athletes often push their bodies to the limit, resulting in muscle strains. Although muscle strains are typically associated with pain and some degree of inflammation, in some severe cases, they can lead to compartment syndrome. This usually occurs when there's swelling in a confined space, leading to increased pressure. For instance, a marathon runner might overexert leg muscles, leading to swelling and consequently increased compartmental pressure.

2. High-Energy Trauma-Induced Compartment Syndrome

Accidents resulting in high-energy trauma, like vehicle collisions or significant falls, can produce fractures or direct muscle injuries. These traumatic events might lead to bleeding within the compartment or swelling, subsequently increasing compartmental pressures. Crush injuries, often seen in industrial accidents, are a classic example. They can cause significant swelling, not just from the injury itself but from the inflammatory response that follows.

3. Non-Traumatic Compartment Syndrome: The “Found Down” Syndrome

An unexpected cause of compartment syndrome is prolonged immobilization, often seen in individuals who have consumed excessive amounts of alcohol or psychoactive substances. In such cases, an individual might fall and remain in the same position for extended periods. This “found down” scenario can lead to prolonged pressure on a limb, resulting in compartment syndrome. The pressure isn't from an external source but rather from the body's weight, combined with the effects of the substance, which can cause muscle breakdown and swelling.

Of note, rhabdomyolysis, the rapid breakdown of muscle tissue, can be both a cause and a result of compartment syndrome. For instance, in the “found down” scenario, the muscle breakdown can lead to swelling and increased compartment pressure. On the flip side, compartment syndrome can lead to muscle death and rhabdomyolysis. Recognizing the types and causes of compartment syndrome is vital for timely diagnosis and treatment. Whether it's a sports injury, a traumatic event, or the unexpected consequence of substance abuse, understanding these categories can guide healthcare professionals in their assessments and interventions, ensuring the best possible outcomes for their patients.

FROM MULTIPARAMETRIC SENSORS TO INDIVIDUALIZED ELECTRICAL PILL

Eugenijus Kaniusas[1], Josef Constantin Szeles[2,3]

[1]Vienna University of Technology, Faculty of Electrical Engineering and Information Technology, Institute of Biomedical Electronics, Austria

[2]Medical University of Vienna, Department of General Surgery, Division of Vascular Surgery, Austria

[3]Health Service Center of Vienna Privat Clinics, Center for Wound Surgery, Austria

Introduction: A multiparametric sensor is used to derive multiple biosignals out of a single sensor. The single sensor is still comfortable for the patient while providing a reasonable amount of vital biosignals. The biosignals reflect physiological parameters of the human body, like cardiac or respiratory activity [1], as required by a real-time biofeedback for closed-loop therapeutic approaches [2], the truly personalized therapy. One of such approaches is the electrical stimulation of the auricular vagus nerve (aVNS), referred to as the electrical pill. The bioelectrical treatment by aVNS is mediated by pulsatile stimulation of sensorial endings of the vagus nerve in the ear [3], the endings providing a direct line into the brain.

Methods: An overview of developed multiparametric sensors and sensing approaches is presented, including the skin curvature sensor, the body sounds sensor, the electrical impedance tomography for lung monitoring, and hybrid sensing for divers monitoring and aneasthesia fitness assessment. aVNS is introduced from its rationale, to mechanistic principles, to technical and modelling issues, down to clinical applications.

Results: The skin curvature sensor registers cardiac and respiratory activity, as well as blood pressure changes. The body sounds sensor registers cardiac and respiratory activity, in addition to sleep apneas. The non-invasive electrical impedance tomography provides 2D ventilation distribution in real time in the lungs. The hybrid sensing reflects aneasthesia fitness, calculated from weighted parameters out of the peripheral vasoconstriction, arterial blood saturation, hear rate, and blood pressure. This electric pill promotes modulation of the autonomic nervous system. The aVNS treatment targets chronic pain diseases, neurodegenerative and metabolic ailments as well as inflammatory and cardiovascular diseases. For the personalization of the electric pill - with reduced side-effects and improved therapeutic efficiency - the closed-loop aVNS can be established with the use of biosignals like electromyogram or pulse plethysmography.

Conclusions: While biophysical mechanistic principles and experimental data uncover the potential clinical effects of the sensorial aVNS, in-silico modelling acts as a tool for optimization of the stimulation set-up. Patient-friendly multiparametric sensors can be used to establish a real-time biofeedback to personalize closed-loop aVNS in line with the time-dependent patient's physiology and the current therapeutic needs of patient.

References:

[1] E.Kaniusas: Biomedical Signals and Sensors I: Linking physiological phenomena and biosignals. Springer Publisher, 296 pages (2012).

[2] E.Kaniusas, S.Kampusch, M.Tittgemeyer, F.Panetsos, R.F.Gines, M.Papa, A.Kiss, B.Podesser, A.M.Cassara, E.Tanghe, A.M.Samoudi, T.Tarnaud, W.Joseph, V.Marozas, A.Lukosevicius, N.Istuk, S.Lechner, W.Klonowski, G.Varoneckas, J.C.Szeles, A.Sarolic: Current Directions in the Auricular Vagus Nerve Stimulation II - an engineering perspective. Frontiers in Neuroscience 13 (772), 1-16 (2019).

[3] E.Kaniusas, S.Kampusch, M.Tittgemeyer, F.Panetsos, R.F.Gines, M.Papa, A.Kiss, B.Podesser, A.M.Cassara, E.Tanghe, A.M.Samoudi, T.Tarnaud, W.Joseph, V.Marozas, A.Lukosevicius, N.Istuk, A.Sarolic, S.Lechner, W.Klonowski, G.Varoneckas, J.C.Szeles: Current Directions in the Auricular Vagus Nerve Stimulation I - a physiological perspective. Frontiers in Neuroscience 13 (854), 1-23 (2019).

VOLUNTARY APNEA IN DIVER: FROM GENESIS TO CONSEQUENCES

Eugenijus Kaniusas

Vienna University of Technology, Faculty of Electrical Engineering and Information Technology, Institute of Biomedical Electronics, Austria

Introduction: Voluntary apnea under water is becoming increasingly popular not only among athletes but also fitness enthusiasts eager to test their physical and psychological limits. Furthermore, voluntary apnea bears some similarities and differences with involuntary sleep apnea, which is highly instructive from a scientific point of view.

Methods: We discuss breath-hold dive from a strategic perspective, starting with the surface time, followed by descent, bottom time, and ascent, and then finishing with the resting on the surface. The ambient and body challenges are discussed, along with the triggered physiological body actions and expected consequences.

Results: The voluntary apnea is an intrinsically instable state triggering multiple physiological and psychological reflex actions of the human body, with the explicit aim to compensate for ceased breathing and/or to resume breathing. The external challenges the human faces include absent air, ambient pressure, and cold. Different phenomena and their consequences are discussed in depth, such as lung packing, blood centralization, Valsalva, diving reflex, nitrogen narcosis, arrhythmia, and others.

Conclusions: The human excellence under water and in apnea shows not only autonomic regulatory fitness of the diver but also demonstrates pathophysiological boundaries. The reflex pathophysiology of the human body in apnea diving offers instructive insights into the pathophysiology of sleep apnea, the involuntary counterpart of voluntary apnea.

Athletes ECG. Is it normal or abnormal?
(Workshop)

Irma Andriuškevičienė, Alma Kajėniėnė

Lithuanian sports center

Sudden cardiac death is the leading cause of mortality in athletes during sport. The majority of cardiac disorders can be identified or suggested by abnormalities on resting electrocardiogram (ECG). A critical need exists for physician education in modern ECG interpretation that distinguishes normal physiological adaptations in athletes from distinctly abnormal findings suggestive of underlying pathology [1].

This workshop is organized for sports medicine physicians and is based on the International Recommendations for Electrocardiographic Interpretation in Athletes.

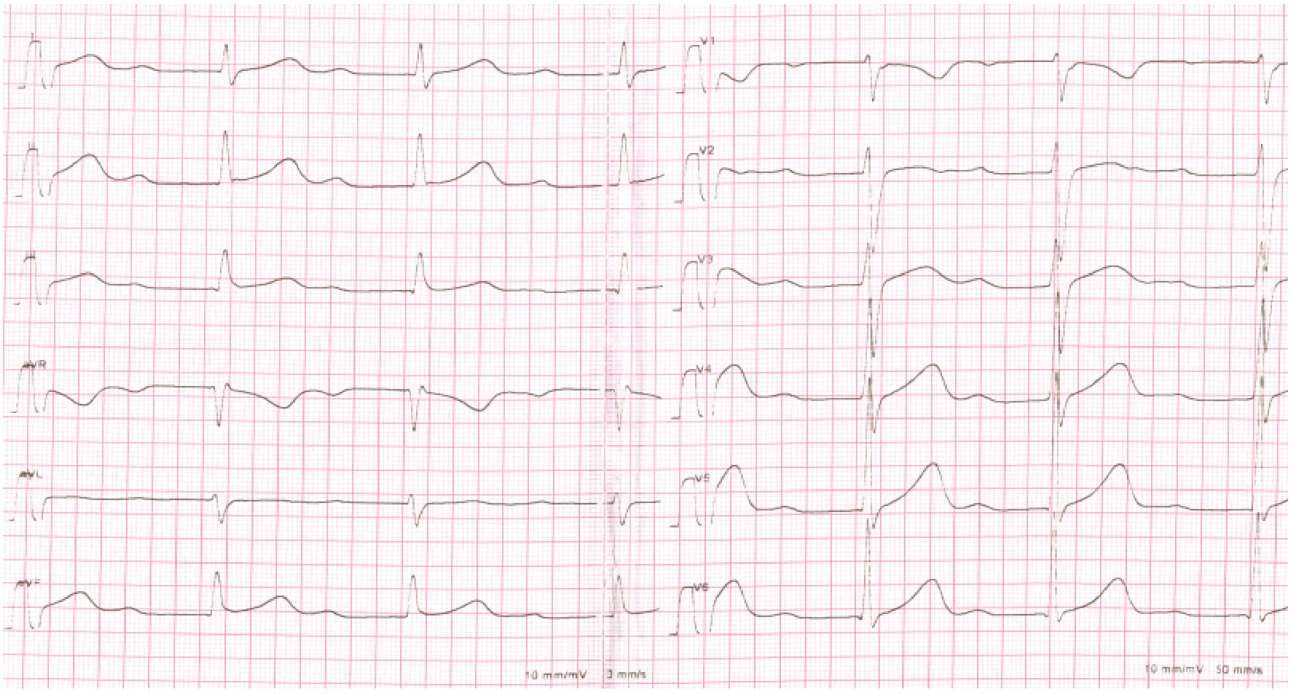

Figure 1. 14 years old basketball player. Family history is negative for cardiac diseases. Normal ECG.

First-degree AV block is found in up to 7.5% of athletes on a resting ECG and is characterised by a prolonged (>200 ms) PR interval. This represents a delay in AV nodal conduction in athletes, due to increased vagal activity or intrinsic AV node changes, and typically resolves with the onset of exercise [1].

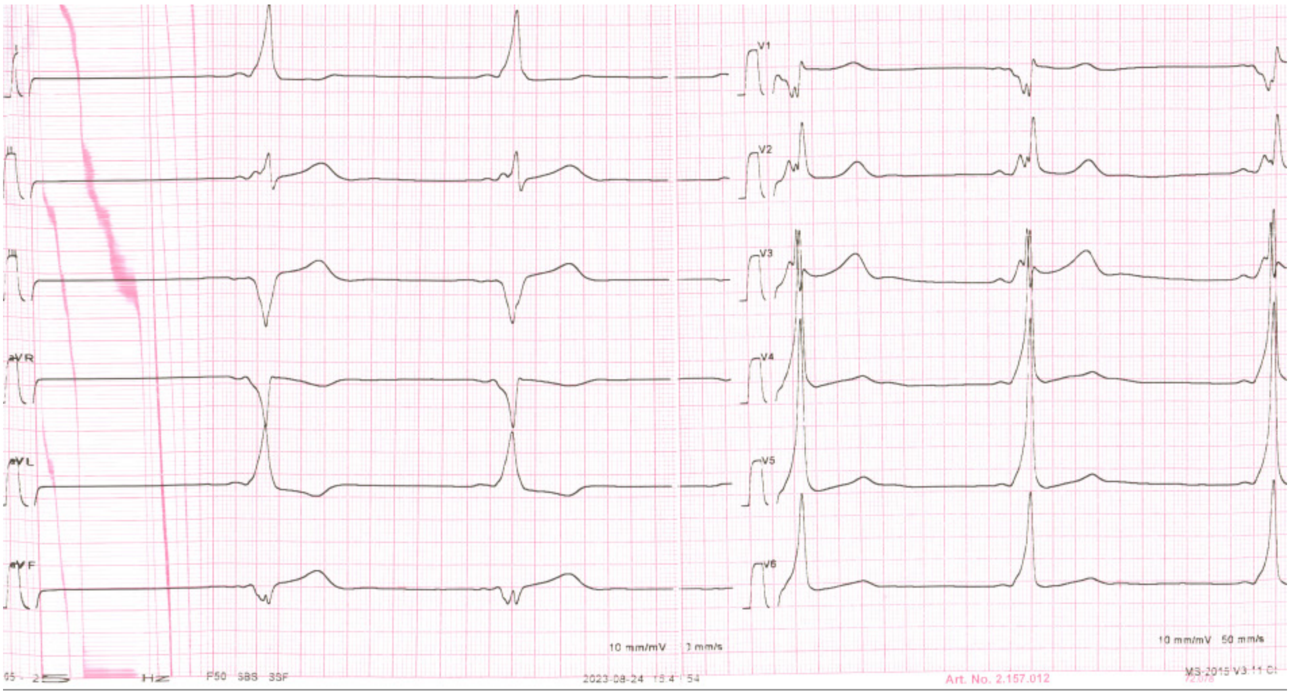

Figure 2. 16 years old asymptomatic swimmer. Family history is negative for cardiac diseases. Abnormal ECG.

The WPW pattern occurs in approximately 1/1000 to 4/1000 athletes. The presence of an accessory pathway can predispose an athlete to sudden death because rapid conduction of atrial fibrillation across the accessory pathway can result in ventricular fibrillation [1].

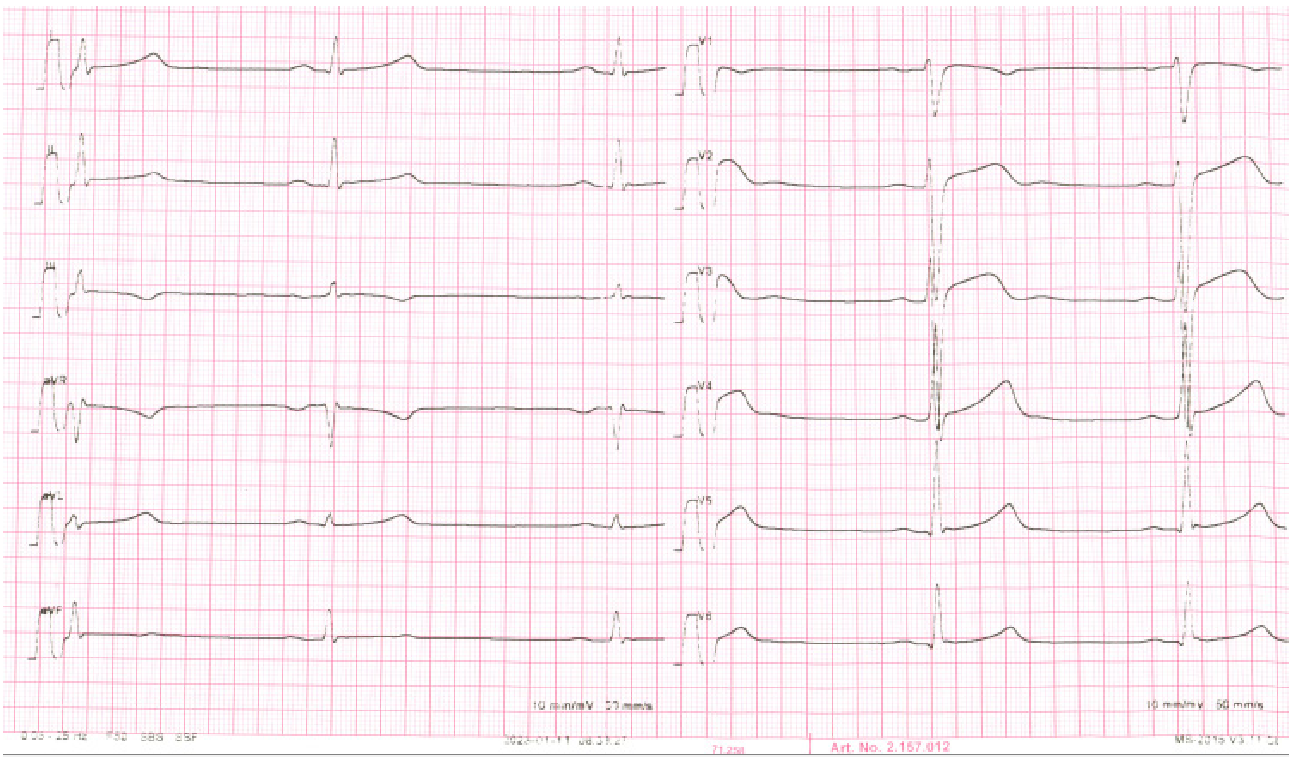

Figure 3. 14-years-old healthy and symptom-free football player. Family history is negative for cardiac diseases. Normal ECG.

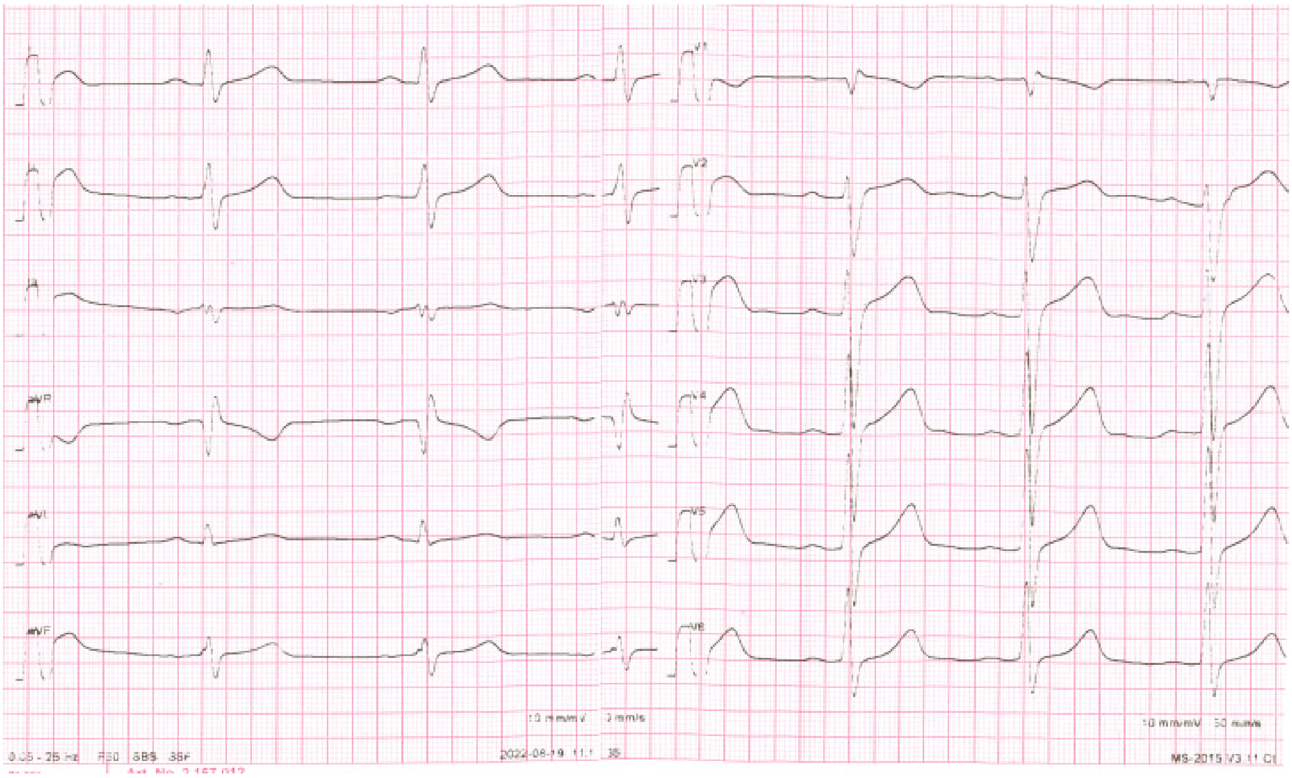

Figure 4. 14-years-old healthy and symptom-free football player. Family history negative for cardiac diseases. Normal ECG.

Ectopic atrial rhythms occur due to a slowed resting sinus rate from increased vagal tone in athletes. Sinus rhythm should resume with the onset of physical activity. In an ectopic atrial rhythm, P waves are present but of different morphology compared with the sinus P wave, typically with a rate ≤100 bpm. Incomplete RBBB is defined by a QRS duration <120 ms with a RBBB pattern: terminal R wave in lead V1 (commonly characterised as an rSR' pattern) and wide terminal S wave in leads I and V6**. Incomplete RBBB represents a phenotype of cardiac adaptation to exercise and in the absence of other features suggestive of disease does not require further evaluation [1].**

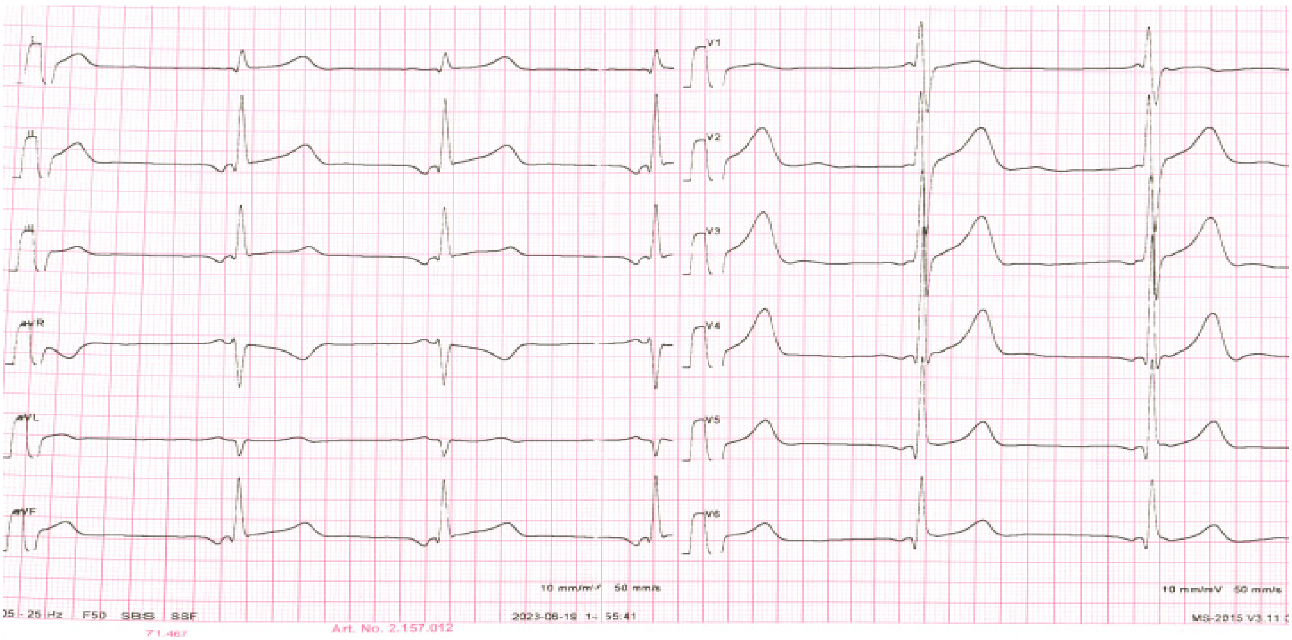

Figure 5. 17-years-old healthy and symptom-free boxer. Family history is negative for cardiac diseases. Normal ECG.

A junctional escape (nodal) rhythm occurs when the QRS rate is faster than the resting P wave or sinus rate, which is typically slower in athletes due to increased vagal tone. The R-R interval is regular in a junctional escape rhythm, and the QRS complexes are narrow unless the baseline QRS has a bundle branch block. Sinus rhythm should resume with the onset of physical activity [1].

Figure 6. 16-year-old healthy and symptom-free boxer. Family history is negative for cardiac diseases. Normal ECG.

Idioventricular rhythm. The hypothesis of physiological AIVR constitutes an increased vagal and decreased sympathetic tone combined with enhanced ventricular pacemaker activity (enhanced automaticity) [2].

Figure 7. 17-years-old healthy and symptom-free basketball player. Family history is negative for cardiac diseases. Normal ECG.

Mobitz type I second-degree AV block, the PR interval progressively lengthens from beat to beat, until there is a non-conducted P wave with no QRS complex. The first PR interval after the dropped beat is shorter than the last conducted PR interval before the dropped beat. This represents a greater disturbance of AV nodal conduction than first-degree AV block, but is usually a normal finding in asymptomatic, well-trained athletes, and 1:1 conduction should return with the onset of exercise [1].

Figure 8. 17 years-old symptom free female wrestler. Family history is negative for cardiac desieses. Abnormal ECG.

In complete AV block, there are more P waves than QRS complexes, and the ventricular rhythm is regular due to an undisturbed junctional or ventricular pacemaker. Complete heart block requires further evaluation for underlying cardiac disease [1].

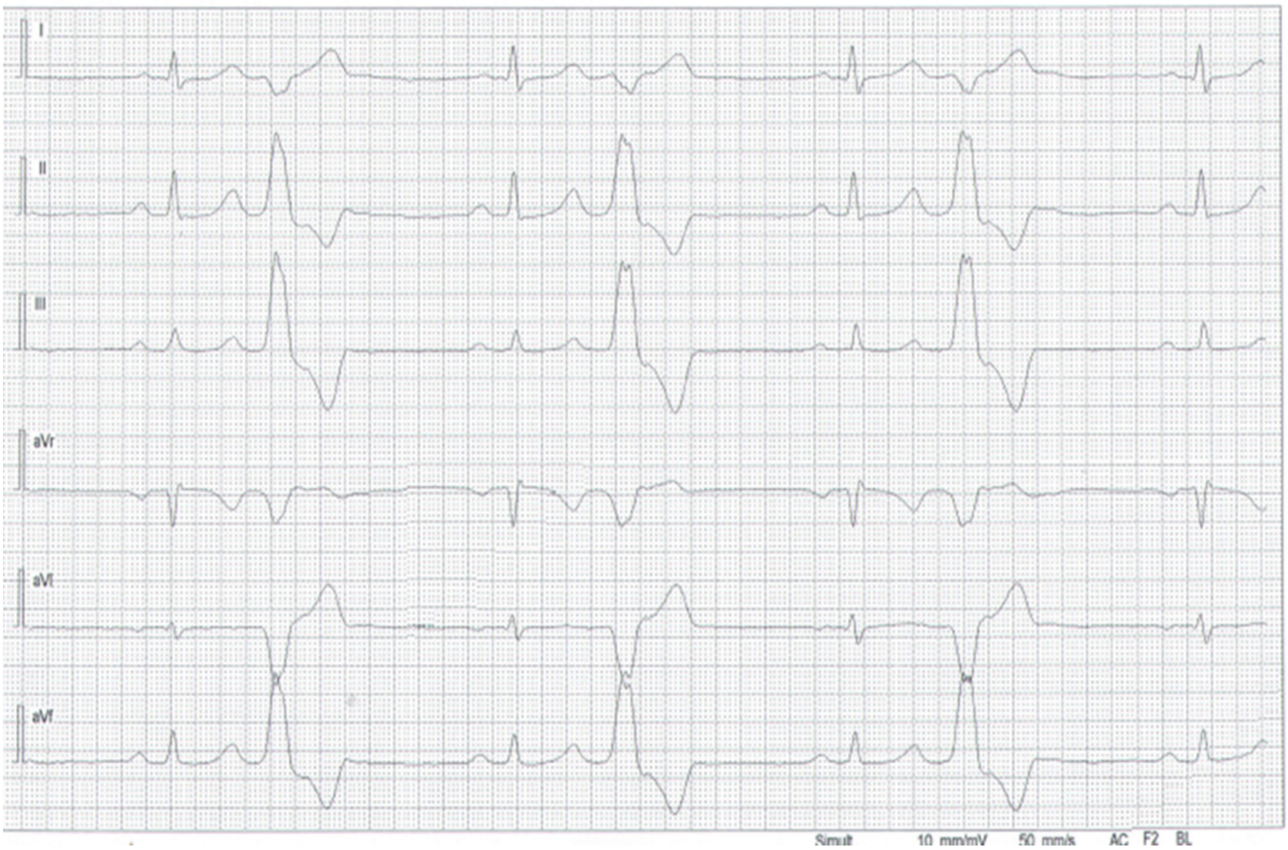

Figure 9. 16-years-old symptom-free soccer player. Family history is negative for cardiac diseases. Abnormal ECG.

Multiple (≥2) premature ventricular contractions (PVCs) are uncommon and present in <1% of athlete ECGs. When 2 or more PVCs are recorded on a standard (10 s) ECG, it is possible the athlete has a high 24 hours PVC burden. The finding of ≥2 PVCs on an ECG should prompt more extensive evaluation to exclude underlying structural heart disease [1].

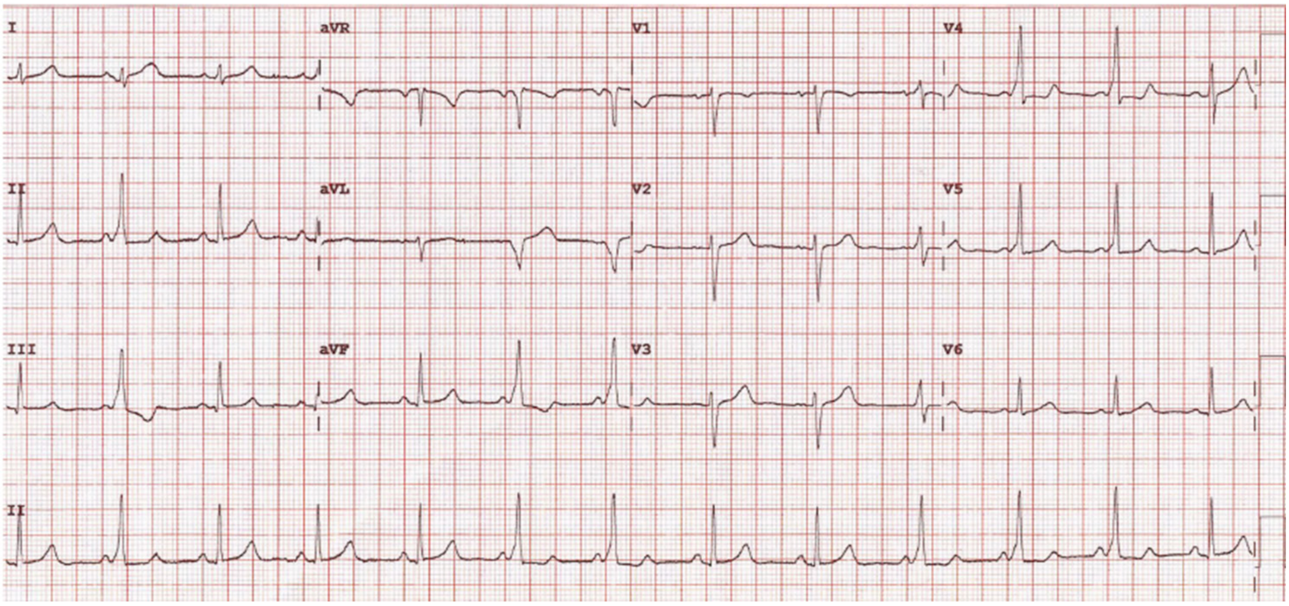

Figure 10. 12-years-old healthy and symptom-free tennis player. Family history is negative for cardiac disease. Abnormal ECG.

The WPW pattern occurs in approximately 1/1000 to 4/1000 athletes. The presence of an accessory pathway can predispose an athlete to sudden death because rapid conduction of atrial fibrillation across the accessory pathway can result in ventricular fibrillation [1].

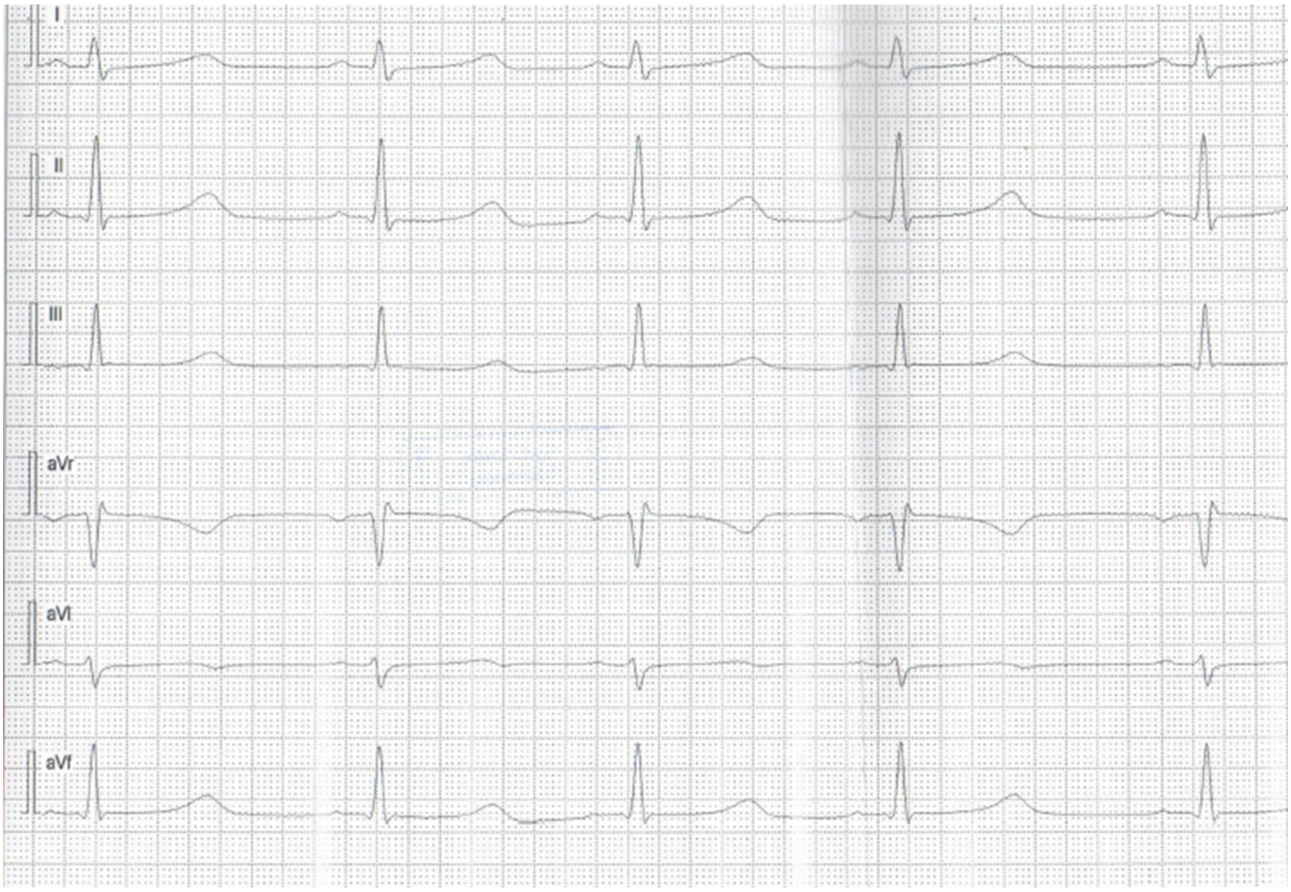

Figure 11. 12-years-old healthy and symptom-free football player. This aunt suddenly died at the age of 24 years. Abnormal ECG.

Congenital QT prolongation is a potentially lethal, genetically mediated ventricular arrhythmia syndrome with the hallmark ECG feature of QT prolongation [1].

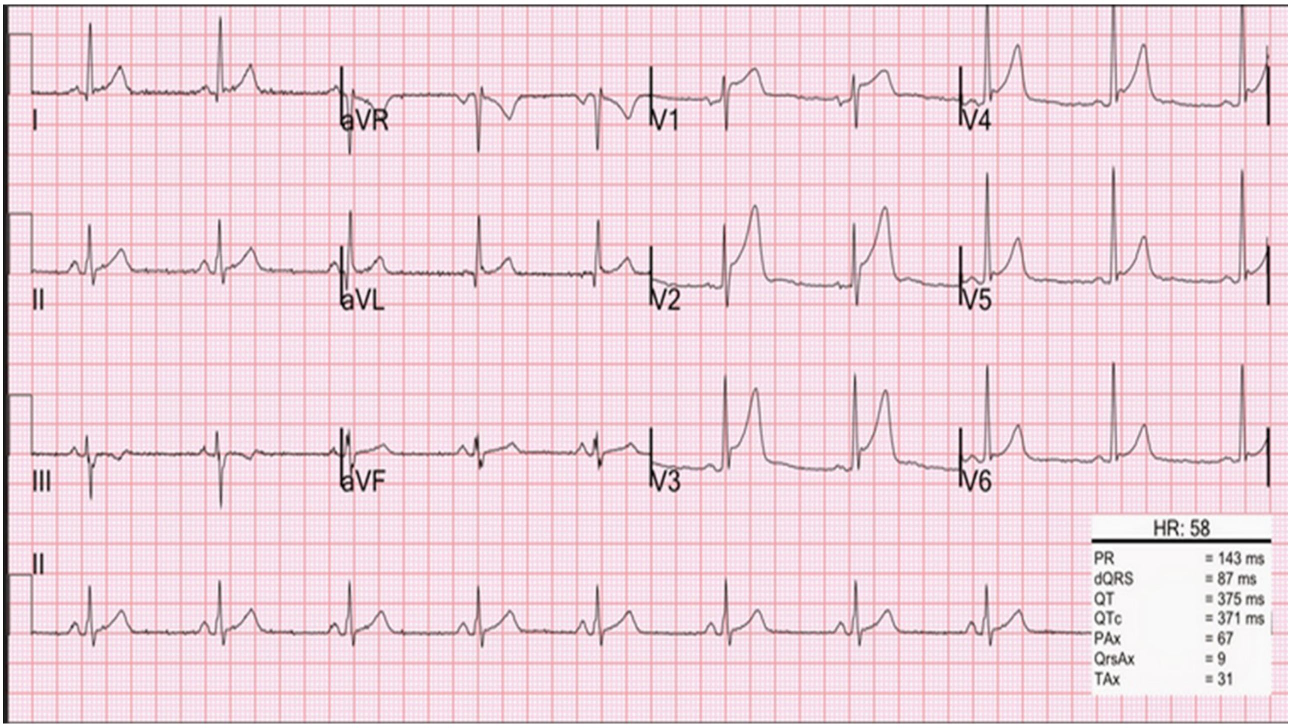

Figure 12. 15-years-old symptom-free football player. Family history is negative for cardiac diseases. Normal ECG.

Early repolarisation is defined as elevation of the QRS-ST junction (J-point) by ≥0.1mV often associated with a late QRS slurring or notching (J wave) affecting the inferior and/or lateral leads. **All patterns of early repolarisation, when present in isolation and without clinical markers of pathology, should be considered benign variants in athletes [1].**

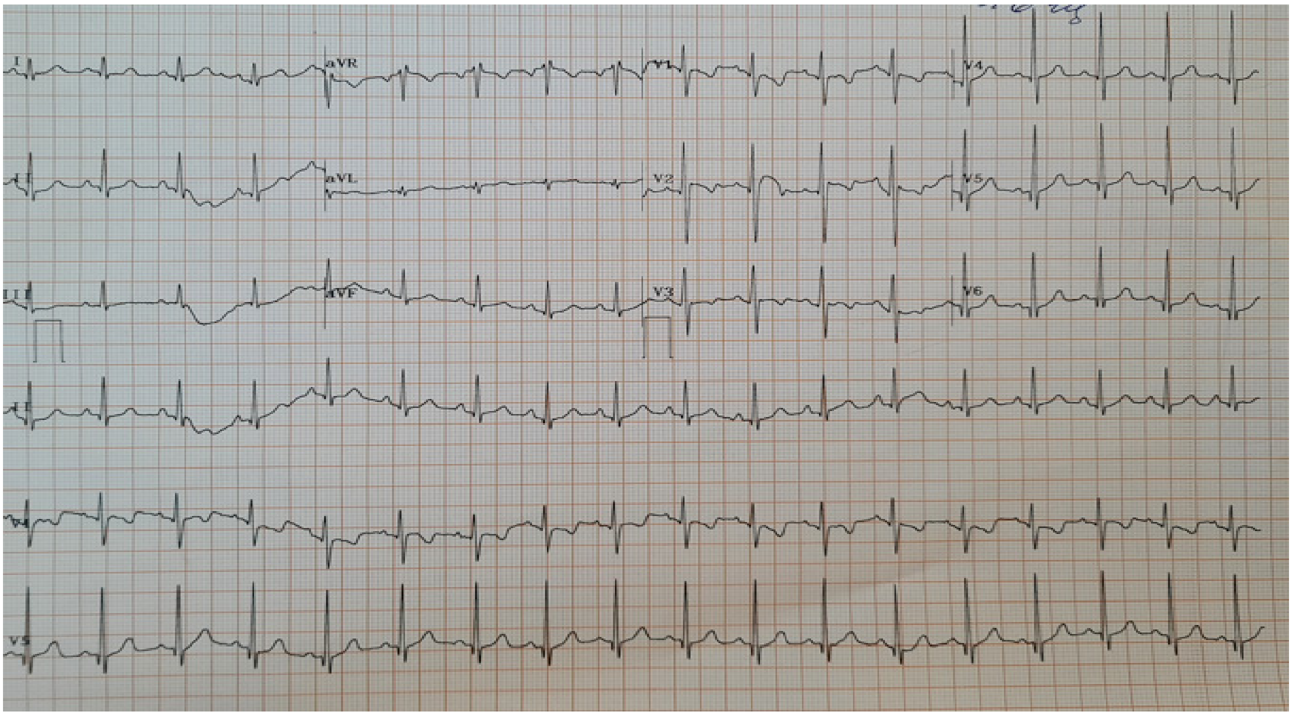

Figure 13. 15-years-old symptom-free football player. Family history is negative for cardiac diseases. Normal ECG.

Juvenile ECG pattern. **T wawe inversion in the anterior leads (V1-V3) in adolescent athletes <16 years of age (or prepubertal athletes) should not prompt further evaluation in the absence of symptoms, signs or a family history of cardiac disease [1].**

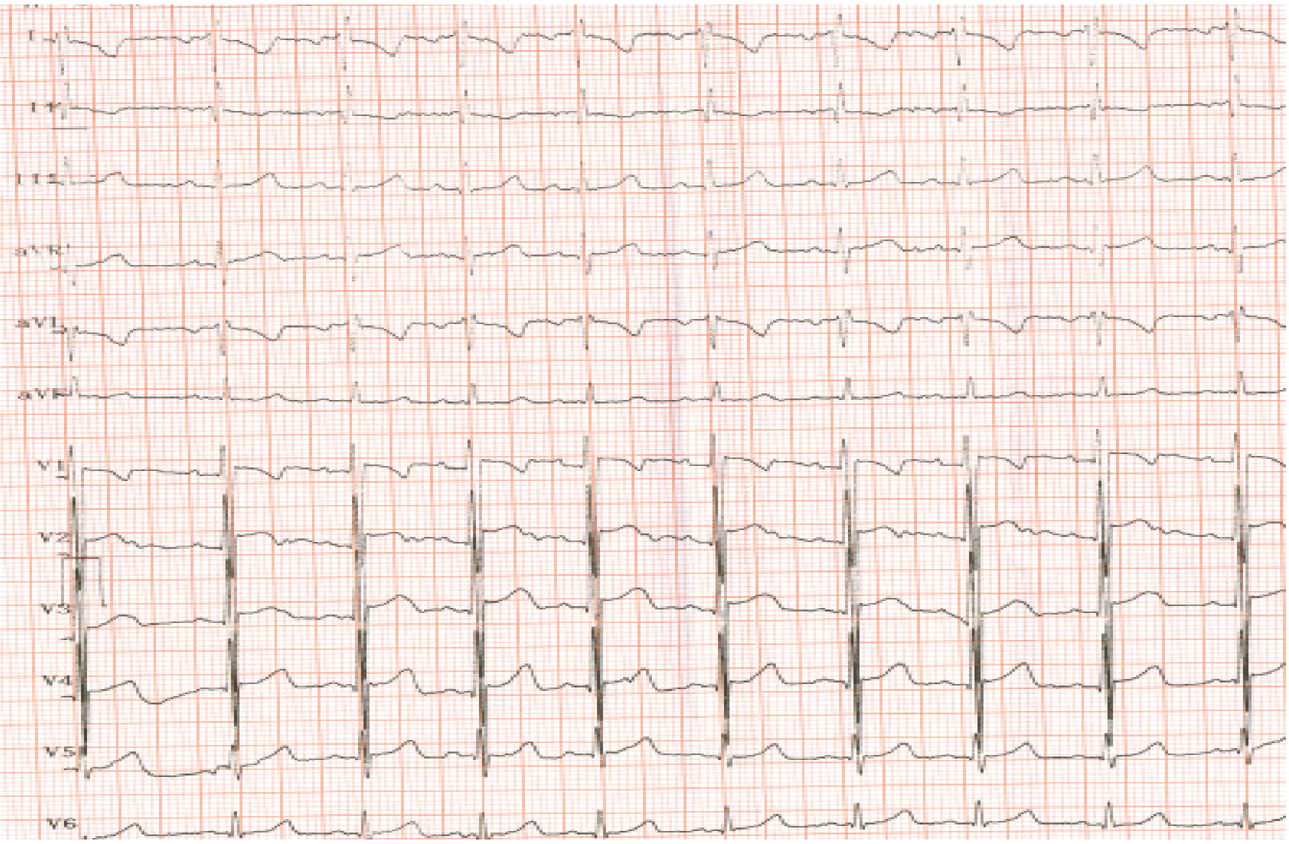

Figure 14. 6 years-old symptom free gymnast. Familly hystory is negative for cardiac desieses.

Abnormal ECG/ Lead reversal. Left arm/Right arm.

References:

1. Sharma S, Drezner JA, Baggish A, Papadakis M, Wilson MG, Prutkin JM, et al. International Recommendations for Electrocardiographic Interpretation in Athletes. D.J Am Coll Cardiol. 2017 Feb 28;69(8):1057-1075. doi: 10.1016/j.jacc.2017.01.015.

2. Nick R. Bijsterveld, Saskia N. Van der Crabben, Maarten Groenink, Arthur Wilde, Harald Jorsted. Accelerated Idioventricular Rhythm in a Young Athlete: Physiology or Pathology?. JACC Case Reports 2022 Dec 7;4(23): 101656. doi: 10.1016/j.jaccas.2022.09.023.

Who are the runners's killers ?

Stéphane Bermon MD, PhD

Health and Science Department, World Athletics, Monaco
LAMHESS, Université Côte d'Azur, Nice, France

Road Running and outdoor running such as trail and mountain running have benefited from an exponential growth during the last decades. This growth is also supported by the participation of individuals with low experience in running, sometimes questionable level of fitness, and irregular training in endurance events. Although one should always emphasize the beneficial effects of endurance exercises like running, it is important for the runners, their medical staff and race organizers to know about the potential lethal medical conditions associated with endurance running; so-called the runners' killers. Sudden cardiac arrest (SCA) is always the most feared one by any endurance runs organizer. Although the beneficial effects of a mandatory pre-participation medical evaluation has been proven by the Italian experience (Corrado et al., 2006), these preventive measures are not implemented worldwide either by lack of resource or different vision of the cost-efficiency of such approach. However, interesting online preventive measures (Sewry et al., 2020) have shown some level of efficacy in detecting subjects at high risk of adverse cardiovascular events during an endurance running competition. Should a SCA occur on the race course, the Japanese experience, providing extremely rapid cardiopulmonary resuscitation (less than one minute) and external electrical shock (less than 3 minutes), showed very high level (more than 95%) of complete cardiac and neurological recovery in participants experiencing a SCA while running (Tanaka et al. 2022). These findings have significant consequences on both the medical staff training and the need for high availability of AED along the racecourse.

Exertional heat stroke (EHS), whereas less considered, is another life-threatening condition which, under some extreme weather conditions, may occur more than ten times more often than SCA (Yankelson et al., 2014). EHS is defined by a core (rectal or esophageal only) temperature > 40.5 °C at the time of collapse associated with cognitive impairment. It is of utmost importance that an athlete with an EHS is quickly identified and **treated on site** through a cold water immersion. The immersion of the patient in cold/icy water (6-12°C) during 10 to 20 min (depending on the athlete body mass and initial core temperature) usually brings the core temperature back to a target value of 39°C, while significantly improving the cognitive symptoms (lethargy, confusion, aphasia, aggressivity,...). It is important to **not transfer the patient to an hospital setting** as long as the core temperature has not reached the target value of 39°C. Indeed, in a case of an EHS every minutes spent with a core temperature > 40° matters and is negatively correlated to positive final clinical outcomes.

Hypothermia may be encountered more often in the context of developing trail and mountain running. As long as the runner walks or runs on cold, windy, rainy, humid conditions, the risk of hypothermia is somewhat limited by the endogenous thermal production. Should the runner get injured, lost or caught by the night without appropriate safety elements, the risks of a mild (rectal temperature < 35°C) and severe (rectal temperature < 30°C) dramatically increase.

Exercise-associated hyponatremia (EAH) is a frequent medical condition in unexperienced or slow runners (Lecina et al, 2022). Most of EAH are mild ([Na+]< 135 nmol/L) or average ([Na+]< 130 nmol/L) and pauci-symptomatic and/or undiagnosed. Severe EAH ([Na+]< 125 nmol/L) are potential lethal conditions because of a significant cerebral oedema causing cognitive impairment, central nervous system dysfunction and ultimately death. The identification of EAH is acheived through the measurement of the [Na+], ideally with a point of care device. Therefore, perfusing athletes after crossing the finish line should always be done with caution, and only after a serum [Na+] check. The mild to average EAH treatment is based on water restriction and oral sodium supplementation (soup, bouillon cube, salty snacks). Severe EAH must be treated with hypertonic saline infusion (100 ml of 3% saline solution) and regular [Na+] checks associated with repeated neurological assessments. As EAH is caused by overdrinking plain water, race organizers should adapt their refreshment station plan according to the existing weather conditions. Specific preventive message, especially in direction of female, slow/unexperienced runners should be repeated invited to **drink when thirsty** and not “preventively”.

As global warming impacts all continents and all runners, a better knowledge of EAH and EHS is important for both the runners and their medical support, to ensure that mass road races remain safe and entertaining sports events.

More information at: https://worldathletics.org/waendurancemedicine

ALTITUDE/HYPOXIC ACCLIMA(TIZA)TION AND PERFORMANCE OPTIMIZATION: FROM MEXICO' 68 TO TODAY

Franck Brocherie, PhD, FECSS

Laboratory Sport, Expertise and Performance (EA 7370), French Institute of Sport (INSEP), Paris, France.

Introduction

While the first studies on altitude/hypoxia date from the fifties or even before, the organization of the 1968 Olympic Games in Mexico (2400 m) drive the first studies carried out on altitude training for elite athletes in the seventies (Dill et Adams, 1971). Since then, interest has been growing, whether in endurance or intermittent sports, giving rise to the evolution in the panorama of altitude/hypoxia training methods (Millet et al., 2013). Recently, heat stress has been proposed as an alternative to altitude or as additional stress (in combination with other altitude/hypoxia methods) (Nybo and Lundby, 2022).

Chronic exposure to environmental

Traditional methods such as "live high-train high" (LHTH) and "live high-train low" (LHTL, considered as the "gold-standard" method) are used to acclimatize before a competition at altitude and/or to increase performance at sea level. The success of these strategies lies in the erythropoietic effect (production of erythrocytes or red blood cells stimulated by erythropoietin or EPO) following natural or simulated chronic hypoxic exposure [LHTH: ~3-4 weeks (Bonetti and Hopkins, 2009); LHTL: >12 h/day for at least 2 weeks (Levine and Stray-Gundersen, 1997)]. Hematological benefits are reflected by an increase in hemoglobin mass (Hb_{mass}), generally accompanied by an increase in maximal oxygen consumption (VO_{2max}). The advantage of the LHTL method is that it overcomes geographical constraints (by remaining at the same residence and training site), individualizing hypoxic dose and training content while maintaining high training intensity at sea level (Wilber et al., 2007). However, the effect of LHTH/LTHL training on increasing Hb_{mass} is debated and would depend on its initial level (Robach and Lundby, 2012) although gains have been observed in highly-trained endurance athletes with high initial Hb_{mass} values (Saunders et al., 2013). Recent analyses (Millet et al., 2019; Skatebo and Hallen, 2022) confirm that development opportunities remain possible.

Finally, if repeated exposure to heat stress allows heat acclima(tiza)tion (Racinais et al., 2019), recent evidence suggests in increase in Hb_{mass} (Nybo and Lundby, 2022), in addition to increased blood volume generally induced by heat acclima(tiza)tion (Racinais et al., 2019). This opens opportunities for the use of heat stress as an alternative to altitude/hypoxia.

Combination of methods

The possibility to combine different altitude/hypoxic training methods had been first mentioned by Millet et al. (2010). Briefly, the "live high-train low and high" (LHTLH) method improved the "aerobic" and "anaerobic" physical qualities of field hockey players, compared with LHTL training combined with repeated-sprint training at sea level or conventional sea-level training (Brocherie et al., 2015). Other combinations, such as the "live high-train high and low" approach or LHTH with additional repeated-sprint training in hypoxia, have also shown increases in physical performance. Besides, when combining altitude/hypoxia training methods with additional exposure to heat stress, current results are conflicting with some authors (Buchheit et al., 2013) advocating a promising "cocktail" and others (McCleaves et al., 2017) much more skeptical by not observing any transfer of physiological gains in terms of cross-tolerance or physical performance.

Conclusion

Since the advent of the benefits of chronic altitude/hypoxia training methods, major progress has been made in improving physical performance and understanding of the underlying mechanisms. Beyond the method considered, the choice of "hypoxic dose" (level and duration) and training load (content, volume, intensity) are crucial to optimize chronic altitude/hypoxic exposure benefits and maximize physical performance. While various interventions, including the use of alternative heat stress can be targeted to improve the different determinants of physical performance, the combination of different altitude/hypoxia approaches with or without additional heat stress remains to be understood for optimal athlete support.

References

Bonetti DL and Hopkins WG. Sea-level exercise performance following adaptation to hypoxia: a meta-analysis. Sports Med. 2009 39(2): 107-127.

Brocherie F, Millet GP, Hauser A, Steiner T, Rysman J, Wehrlin JP, Girard O. "Live High-Train Low and High" hypoxic training improves team-sport performance. Med. Sci. Sports Exerc. 2015 Oct;47(10): 2140-2149.

Buchheit M, Racinais S, Bilsborough J, Hocking J, Mendez-Villanueva A, Bourdon PC, Voss S, Livingston S, Christian R, Périard J, Cordy J, Coutts AJ. Adding heat to the live-high train-low altitude model: a practical insight from professional football. Br J Sports Med. 2013 Dec;47 Suppl 1(Suppl 1):i59-69.

Dill DB and Adams WC. Maximal oxygen uptake at sea level and at 3,090-m altitude in high school champion runners. J. Appl. Physiol. 1971 Jun;30(6): 854-859.

Levine BD and Stray-Gundersen J. "Living high-training low": effect of moderate altitude acclimatization with low-altitude training on performance. J. Appl. Physiol. 1997 Jul;83(1): 102-112.

Millet GP, Roels B, Schmitt L, Woorons X, Richalet JP. Combining hypoxic methods for peak performance. Sports Med. 2010 Jan;40(1): 1-25.

Millet GP, Brocherie F, Faiss R, Girard O. Hypoxic training and team sports: a challenge to traditional methods? Br. J. Sports Med. 2013 Dec;47: 6-7.

Millet GP, Chapman RF, Girard O, Brocherie F. Is live high-train low altitude training relevant for elite athletes? Flawed analysis from inaccurate data. Br J Sports Med. 2019 Aug;53(15): 923-925.

McCleave EL, Slattery KM, Duffield R, Saunders PU, Sharma AP, Crowcroft SJ, Coutts AJ. Temperate Performance Benefits after Heat, but Not Combined Heat and Hypoxic Training. Med Sci Sports Exerc. 2017 Mar;49(3): 509-517.

Nybo L, Rønnestad B, Lundby C. High or hot-Perspectives on altitude camps and heat-acclimation training as preparation for prolonged stage races Scand J Med Sci Sports. 2022 Nov.

Racinais S, Casa D, Brocherie F, Ihsan M. Translating Science Into Practice: The Perspective of the Doha 2019 IAAF World Championships in the Heat. Front Sports Act Living. 2019 Sep;27(1):39.

Robach P and Lundby C. Is live high-train low altitude training relevant for elite athletes with already high total hemoglobin mass? Scand. J. Med. Sci. Sports. 2012 Jun;22(3): 303-305.

Saunders PU, Garvican-Lewis LA, Schmidt WF, Gore CJ. Relationship between changes in haemoglobin mass and maximal oxygen uptake after hypoxic exposure. Br. J. Sports Med. 2013 Dec;47: 26-30.

Skattebo Ø, Hallén J. Individual variations in pre-altitude hemoglobin mass influence hemoglobin mass responses to repeated altitude sojourns. Scand J Med Sci Sports. 2022 Oct;32(10): 1493-1501.

Wilber RL. Application of altitude/hypoxic training by elite athletes. Med Sci Sports Exerc. 2007 Sep;39(9): 1610-24.

NEW APPROACHES USING ENVIRONMENTAL STRESSORS TO TARGET PERFORMANCE AND HEALTH ENHANCEMENT

Franck Brocherie, PhD, FECSS

Laboratory Sport, Expertise and Performance (EA 7370), French Institute of Sport (INSEP), Paris, France.

Introduction

In recent times, due to the technological development of new hypoxic devices and facilities, the "living low-training high" (LLTH) altitude/hypoxia paradigm – that include numerous methods using either systemic or local hypoxia stimuli, or a combination of both – is now important for performance enhancement in many sports. Interest has also emerged in using heat stress as an alternative of hypoxia in resistance training and repeated-sprint training. Such environmental approaches also appear promising for potential translation to rehabilitation, prevention and therapeutic protocols.

Intermittent exposure to environmental stress

During high-intensity intermittent exercise, physical performance depends not only on the oxygen-carrying capacity, but also on molecular adaptations and improved efficiency of the neuromuscular system. The LLTH approach provides an additional hypoxic stimulus (Hoppeler and Vogt, 2001) during a training session, compared to the same training performed at sea level. Among the different variations of the LLTH approach, two particular methods have attracted particular interest in recent years.

Resistance training in hypoxia

During strength training performed in hypoxia [so-called "resistance training in hypoxia" (RTH), historically developed from arterial occlusion (blood flow restriction, BFR) before being declined into a systemic hypoxic version], partial oxygen deprivation in blood and tissue increases the metabolic stress (i.e., dependence on anaerobic pathways) and consequently hypertrophic responses (Scott et al., 2014). However, current results concerning the efficacy of RTH are contrasting, mostly due to the use of different hypoxic doses and training loads between studies.

Repeated-sprints training in hypoxia

The repeated-sprints training in hypoxia (RSH) method involves performing short-duration maximal efforts ($\leq$ 30 s) in hypoxia, interspersed with phases of incomplete recovery (Brocherie et al., 2017a). The growing number of results in favor of RSH seems to highlight an effective and well-tolerated training model (Brocherie et al. 2017b). Numerous studies have been published to date, providing some relevant evidence-based information for refining the recommendation to practitioners.

Benefits of additional heat stress?

Very recently, the addition of heat stress during resistance training (Nakamura et al., 2019) repeated-sprint training (Girard et al., 2013; Gale et al., 2021) or has also been shown to improve physical performance, conferring an alternative to hypoxia and/or substantial interest in the possibility of combining hypoxia and heat to maximize physiological adaptations and performance gains. However, the contrasting results following their combination (Dennis et al., 2021; Yamaguchi et al., 2020) raise the question of whether the addition of heat stress during RSH training induces greater physiological and/or mechanical stress, likely to alter responses and consequent adaptations. Future investigations are needed to confirm the interest to combine environmental stress in training, in addition to their potential cross-talk effects from one stress to another.

Therapeutic promises

The aforementioned methods initially developed to induce hypoxic- and/or heat-induced factors during exercise or training, likely to improve physical performance, may also appears as a viable and non-pharmacological therapeutic strategy contributing to the health and well-being of healthy participants (along the continuum of sport participation levels), patients with co-morbidities (e.g., obesity, hypertension, diabetes) and elderly people (Brocherie et al., 2020; Millet et al., 2016). Recognizing that there is no "one-size-fits-all" model in clinical settings, continuous effort based on in-situ athlete and patient-centered studies will help to translate new findings into guidance on the modalities of exercise prescription in challenging environmental conditions.

Références

Brocherie F, Girard O, Faiss R, Millet GP. Effects of Repeated-Sprint Training in Hypoxia on Sea-Level Performance: A Meta-Analysis. Sports Med. 2017a Aug;47(8):1651-1660.

Brocherie F, Millet GP, Girard O. Psycho-physiological responses to repeated-sprint training in normobaric hypoxia and normoxia. Int. J. Sports Physiol. Perform 2017b Jan;12(1):115-123.

Brocherie F and Millet GP. Hypoxic exercise as an effective nonpharmacological therapeutic intervention. Exp Mol Med. 2020 Mar ;52(3):529-530.

Dennis MC, Goods PSR, Binnie MJ, Girard O, Wallman KE, Dawson B, Billaut F, Peeling P. Increased air temperature during repeated-sprint training in hypoxia amplifies changes in muscle oxygenation without decreasing cycling performance. Eur J Sport Sci. 2021 Dec 8:1-11.

Gale RM, Etxebarria N, Pumpa KL, Pyne DB. Cycling-based repeat sprint training in the heat enhances running performance in team sport players. Eur J Sport Sci. 2021 May;21(5):695-704.

Girard O, Bishop DJ, Racinais S. Hot conditions improve power output during repeated cycling sprints without modifying neuromuscular fatigue characteristics. Eur J Appl Physiol. 2013 Feb;113(2):359-69.

Hoppeler H and Vogt M. Muscle tissue adaptations to hypoxia. J. Exp. Biol. 2001 Sep;204, 3133–3139.

Millet GP, Debevec T, Brocherie F, Malatesta D, Girard O. Therapeutic Use of Exercising in Hypoxia: Promises and Limitations. Front Physiol. 2016 Jun;10;7:224.

Nakamura M, Yoshida T, Kiyono R, Sato S, Takahashi N. The effect of low-intensity resistance training after heat stress on muscle size and strength of triceps brachii: a randomized controlled trial. BMC Musculoskelet Disord. 2019 Dec;20(1):603.

Scott BR, Slattery, KM, Dascombe BJ. Intermittent hypoxic resistance training: does it provide added benefit? Front. Physiol. 2014 Oct;5, 397.

Yamaguchi K, Kasai N, Hayashi N, Yatsutani H, Girard O, Goto K. Acute performance and physiological responses to repeated-sprint exercise in a combined hot and hypoxic environment. Physiol Rep. 2020 Jun;8(12):e14466.