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Revista de la Sociedad Española de Medicina del Deporte

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Summary / Sumario

Exercise Prescription for Health: The Role of Genetics and Epigenetics

Prescripción de ejercicio para la salud: el papel de la genética y de la epigenética

Norbert Bachl[1], Herbert Löllgen[2], Petra Zupet[3], Joe Cummiskey[4,†], André Debruyne[5]

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Preamble

It was Prof. Per Olaf Astrand in the Sixties of the last Century, who stated: "There are many results of scientific studies concerning the effects of physical training and an active lifestyle in the field of primary and secondary prevention of specific diseases, the so-called "Current Exercise Prescriptions".

Based on that, Prof. Astrand raised the following question: "But do we have the right to manipulate the lifestyle of 100 persons in a program if we save only 3/10/50/70/90 lives, where the remaining 97/90/50/30/10 did not like the program or did not respond but were forced to participate".

This was a very wise future direction verbalised at that time. A plethora of genetic and epidemiological studies were born of this insight. These helped to differentiate females and males with high genetic risk and those with low genetic risk for different non-communicable diseases. Within these studies coronary artery diseases are the best ones evaluated. Hand in hand with these findings, a lot of scientific studies, from which the "Heritage-study" by Claude Bouchard was one of the first. This revealed, that prescribed and strictly controlled training regulations my show different effects concerning high responders and low responders (Bouchard C. *et al.,* 1995).

Introduction

When prescribing exercise and physical activity, universally valid and applicable regulations are necessary, to make it useable and practicable for all health professionals. Therefore a lot of national and world-wide functioning federations as European Federation of Sport Medicine (EFSMA), WHO, International Federation of Sport Medicine (FIMS), American College of Sport Medicine (ACSM) and many others have developed training regimens for all humans of both sexes, over the whole age range and under different environmental conditions.

Consequently, a lot of world-wide epidemiological studies showed a risk reduction between 20 and 50% for morbidity and mortality of different chronic non-communicable diseases. These included, among others, cardiovascular diseases, type II diabetes, hyperlipidemia, breast- and colon cancer, Alzheimer's disease, dementia, respiratory diseases, when people are active, (desirable) over their whole lifespan.

Combining results from genetic research, both on risk factors and on the effects of endurance and strength training, it would be the optimal solution to finish up with a "Personalized Exercise Prescription" in the future. Although a lot of traits and genetic polymorphisms are well known in both areas, research is just at the starting line to guarantee validity and objectivity in this just mentioned personalization. The same is true for the prediction of talented young athletes and/or the maximum performance as it is clearly stated in a paper from Webborn N. *et al.*, 2015. As a consequence of this a lot of research has and must continue to be done like the Athlome Project (Pitsiladis Y. *et al*., 2016).

To increase the health in different populations, especially in older aged individuals and to maintain mobility and high quality of life, it is essential to combine the state of the art knowledge of the genetic and the epigenetic influence on different diseases using general recommendations and to break them down to personalized advice. A very impressive example was recently published by AV. Khera, *et al.,* 2016: "Genetic Risk, Adherence to a Healthy Lifestyle and Coronary Disease".

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Introducing the topic, the authors stated, "that both genetic and lifestyle factors are key drivers to develop coronary disease, that is a leading cause of death worldwide". This a state of affairs, which is known as "Sedentary Death Syndrome" (Lees SJ et Booth FW, 2004), the Exercise Deficiency Syndrome (Cummiskey *et al*, 2018) and Exercise deficiency disorder (EDD) (Faigenbaum *et al,* 2011).

Exercise Deficiency Syndrome

We are suggesting that a diagnosis of Exercise Deficiency Syndrome (EDS) should be the first step in a one on one exercise program prescription. Medicine to-day is practiced by first making a diagnosis. This diagnosis usually has a ICD code or a WHO number. This diagnosis has a differential diagnosis. Based on all the information available to the physician at that time, including from office tests, wet laboratory and exercise physiology laboratory a decision is made on a management plan. There is then a follow up with objective testing and a prognosis for that diagnosis. We see a diagnosis of EDS as the first move to act on these non-communicable diseases.

The editors of the journal where EDD was coined said it was a medicalizing of behavioral disorders (Faigenbaum *et al* 2011. Editor's comment). This is not correct and needs to be fought vigorously by the medical exercise community. What we have found is that many gyms, internet companies, and some of our own medical organizations have already commercialized exercise prescription for health. Some have done this without any reference to the science and proof of the use of exercise in the prevention and management of disease. They have dumbed down exercise as a scientific modality of management as they pursue a low grade approach to exercise as a modality of prevention and management in healthy people and to a lesser extent in patients with chronic disease (Faigenbaum AD *et al*., 2011).

Genome-wide associations

In the Khera paper the authors state, that since 2007 analyses of genome-wide associations have identified more than 50 independent loci associated with the risk of coronary artery disease. On the other hand, there is – as mentioned before – strong evidence, that the promotion of healthy lifestyle behaviours, mainly non-smoking, avoiding obesity, regular physical activity and healthy diet patterns improve the cardiovascular health in the general population. To calculate the risk of coronary events, they summarized the adjusted hazard ratios for coronary events of three prospective cohort studies, according to genetic and lifestyle risks.

Epidemiology

The Arteriosclerosis Risk in Communities (ARIC-Study), the Women's Genome Health Study (WGHS) and the Malmoe Diet and Cancer Study (MDCS), was all together a cohort of nearly 50.000 persons. Participants at *low genetic risk with a favorable lifestyle* (non-smokers, without obesity (BMI <30), physical activity at least once weekly and healthy diet pattern) served as the reference group and *1,00 as a reference favourable lifestyle.*

Table 1. Adjusted hazard ratio for coronary events depending upon genetic risk and lifestyle.

N = ~50,000		
Participants at low genetic risk with a favorable lifestyle had 1,00 as a reference		
An adjusted hazard ratio (95% CI) for the with **low** genetic risk		
1.82	(1.51-2.19)	in the unfavourable lifestyle group
1.16	(0.98 to 1.38)	with the intermediate lifestyle,
1.00	as a reference	favourable lifestyle.
An adjusted hazard ratio (95% CI) for the group with **intermediate** genetic risk		
2.52	(2.18 to 2.92)	for the unfavourable lifestyle,
1.54	(1.34 – 1.77)	for the intermediate Lifestyle
1.33	(1.15 – 1.54)	for the favourable lifestyle.
An adjusted hazard ratio (95% CI) for the group with **high** genetic risk showed		
3.50	(2.97 – 4.12)	with unfavorable lifestyle,
2.24	(1.93 – 2.61)	with intermediate lifestyle and
1.90	(1.62 – 2.32)	for favorable lifestyle.

Results showed (Table 1) that an adjusted hazard ratio (95% CI) was always improved in groups with high, through intermediate to lower genetic risk for coronary events if the lifestyle improved from unfavourable, through intermediate to favourable lifestyle. This adjusted hazard ratio was also always better when the genetic risk was lower or intermediate compared to high. The authors concluded, that persons with a high polygenetic risk category, complying adherence to a healthy lifestyle were associated with a significant risk reduction of single coronary events and subclinical burden of "coronary artery disease". Although the absolute risk reduction was the highest in the group of high genetic risks, data strongly support, that exercise prescriptions, as an essential part of a healthy lifestyle are effective for everyone.

Conclusions

This and other studies show very clearly, that health politicians and all health professionals in the frame of Public Health, from WHO to regional authorities should promote a more active lifestyle in the population, because the costs of care of chronic non-communicable diseases in the community are increasing, are becoming unsustainable and need to be highlighted.

Under the viewpoint of this and other papers, every "Healthcare-Euro" must be considered for redirection into prevention because only lifestyle changes and healthcare are sustainable together. The exercise prescription for health, like the EPH-EFSMA Program (Cummiskey J *et al,* 2017), is a meaningful instrument (http://www.efsma-scientific.eu/exercise-prescription-for-health/) to help physicians and all other health professionals to advise patients with a very carefully designed exercise program, both for healthy and diseased persons and with the possibility to personalize it through individual advice with each patient (Löllgen H. *et al.,* 2004, 2017; Zupet P. *et al*., 2016; Cummiskey J, *et al*. 2017).

In addition, a close cooperation of all European federations active in the field of physical activity is strongly recommended as an European alliance against sedentary lifestyle and Exercise Deficiency Syndrome.

Dedicatory

† Devoted to the former EFSMA-Executive Member and President, an excellent scientist and sports physician and great friend.

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Epidemiology of injury in a non professional basketball club during a regular season: a prospective study

Pablo Carnero Martín de Soto[1,2], Juan F. Abellán Guillén[3,4], Alfredo Rodríguez León[2], María J. Bravo Zurita[5], Ismael Menéndez Quintanilla[1]

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Summary

Introduction: The knowledge about patterns of injury in non professional and adolescent basketball players is the base for prevention programs. While large series about injuries in professional basketball players have been published previously, little is known in non professional and young-in-training athletes. This study aims to describe the epidemiology of injuries, relate it with gender and type of activity in a non-professional basketball club over one season.
Material and method: Two hundred and thirty players (Mean age: 17.3, SD 5.7 years, 73.9% males) were enrolled in a one season prospective study. An injury report form was used to systematically collect all data and was filled weekly by each player. Characteristics of injuries were described and its distribution by gender and type of activity. Incidence of injury is shown as number of injuries /1000 hours exposure.
Results: Overall incidence was 3.86 injuries /1000h. The ankle (32.3%) was the most common location of injury and sprain (35.5%) the most frequent diagnosis, which was also seen in subgroups analysis. Mean time loss was 7.52 sessions (SD 11.28) Wrist injuries meant largest time loss (14.5 sessions, SD 13.43). Males showed higher incidence than females (4.16/1000h vs 3.04/1000h), who were more prone to fractures and upper extremity injuries. During competition, incidence of injury was 11.7 times higher than practices, and patterns of injury differed in each setting.
Conclusion: Ankle sprain was the most common injury in our study. Wrist injuries meant the longest time loss. Males got injured more often than females. Injuries during competition were notably more frequent than during practice with different patterns of injuries.

Key words:
Sports. Adolescent. Incidence. Ankle. Sprain.

Epidemiología lesional en club de baloncesto no profesional durante una temporada regular: estudio prospectivo

Resumen

Introducción: Conocer los patrones de lesión en baloncesto es la base para desarrollar programas preventivos. Aunque se han publicado grandes series en jugadores profesionales, poco se conoce sobre jugadores en formación y no profesionales. El objetivo de este estudio es describir la epidemiología de las lesiones en un club de baloncesto no profesional durante una temporada, y relacionarla con el género y el tipo de actividad competitiva.
Material y método: Doscientos treinta jugadores (edad media: 17,3, DS 5,7 años, 73,9% varones) se incluyeron en un estudio prospectivo a lo largo de una temporada. Un cuestionario sobre aparición de lesiones se utilizó para registrar los datos y se rellenó semanalmente por cada jugador. Se describieron las características de las lesiones y su distribución por género y tipo de actividad. La incidencia lesional se muestra como número de lesiones/1000 horas de exposición.
Resultados: La incidencia global fue de 3,86 lesiones /1.000 h. El tobillo (32,3%) fue la localización más común y el esguince (35,5%) el diagnóstico más frecuente. Esto también se observó en los análisis de subgrupos. El tiempo medio de baja fue de 7,52 sesiones (DS 11,28). Las lesiones de la muñeca conllevaron tiempos de baja más prolongados (14,5 sesiones, DS 13,43). Los varones presentaron una incidencia mayor que las mujeres (4,16/1000h *vs* 3,04/1000h), las cuales mostraron mayor tendencia a sufrir fracturas y lesiones del miembro superior. La incidencia de lesión durante la competición fue 11,7 veces mayor que durante el entrenamiento, y los patrones de lesión diferían.
Conclusión: El esguince de tobillo fue la lesión más frecuente en nuestro estudio. Las lesiones de muñeca supusieron mayores tiempos de baja. Los varones se lesionaron con más frecuencia que las mujeres. Las lesiones durante la competición fueron notablemente más frecuentes que durante el entrenamiento y presentaron diferente espectro.

Palabras clave:
Deporte. Adolescente. Incidencia. Tobillo. Esguince.

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Introduction

Basketball is the second most practiced sport in the world after football. About 11% of world population has played basketball at different levels of competition. The International Basketball Federation (FIBA) represents 213 national federations and about 450 million players[1]. The Spanish Basketball Federation counts with 400153 licensed players and 3968 clubs[2].

The description of the epidemiology of injuries of every sport is the basis to develop injuries prevention programs. However, published epidemiological registries vary in methodology and in the communication of results, which complicates obtaining reliable conclusions[3]. Results also differ widely depending on the population of study, like professional players[4], non-professional / recreational[5] or young-in training- players[6-8].

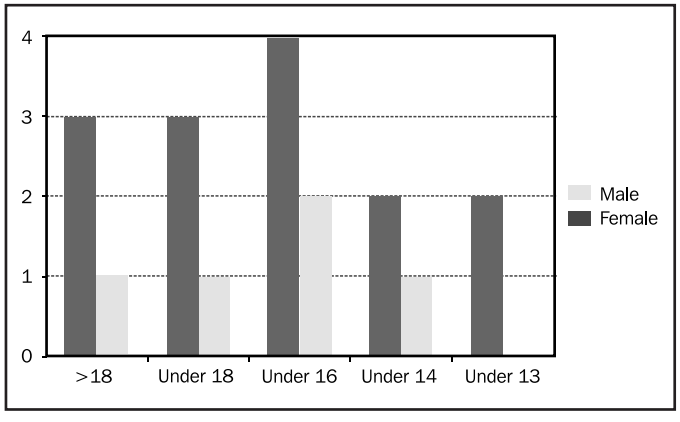
Several databases have been developed in an attempt to analyze information about injuries in basketball. The vast majority of the high-quality publications about this issue are based on them[9-11].

The knowledge about injuries in our geographical area could provide excellent information to develop prevention programs in non-professional and adolescent players, who are the majority of players in the world. The aim of this study is to describe the epidemiology of injuries, relate it with gender and type of activity and to establish the incidence of injury in non-professional basketball players belonging to a Spanish non-professional basketball club.

Material and method

Approval from the ethical committee from the Hospital Regional Universitario de Malaga was obtained. A prospective observational study was carried out registering injuries during the 2015 – 2016 regular season in a local non-professional basketball club. Nineteen teams were enrolled (14 male, 5 female) with a total of 230 players included (170 men, 60 women). Each team participated in their corresponding age-category league. Figure 1 represents categories of every participating team. Inclusion criteria were players aged 12 to 40 that participated in teams with a minimum of 2 practice sessions every week. Exclusion criteria were players under 12 or over 40, athletes that declined to participate and injuries that happened before the beginning of the preseason or after the end of the regular season. Informed consent was obtained from all participants.

Figure 1. Categories of participant teams.



An injury report form was developed based on a previous form of the Epidemiological Study of the Spanish Medical Basketball Association[12], which was adapted to the characteristics of non-professional and young- in training players. Information about age, sex, height, weight, side of injury, player position, type of injury, mechanism, location of injury, time loss measured as number of training or games lost, type of return to play (complete return to play, partial return to play with individual training or partial return to play with collective training), moment of the season (preseason, first half of regular season, second half of regular season), type of activity at the moment of injury (training or competition) and weekly time of exposure to training and games were collected.

An injury was defined as any harm sustained during training or competition resulting in inability to play. The form was filled weekly by every athlete included in the study. Diagnosis of injury was confirmed by the team doctor, who also performed the weekly follow up of injured players.

Qualitative data are shown as average, quantitative as mean and standard deviation (SD). Incidence is represented as injuries /1000 h exposure. Chi-square test was used to compare categorical variables; non-parametric tests were used to compare continuous data. p-values < 0.05 were considered statistically significant. All statistical analysis was conducted by the use of the program SPSS 20.0 (IBM CORPORATION, Armonk, NY, USA).

Results

A total of 124 injuries were diagnosed during the study period. Mean age of injured players was 17.27 (SD 5.69) years old. Mean height and weight of injured players were 1.76 (SD 0.1) meters and 73.17 (SD 10.89) kilograms respectively. Mean weekly exposure was 5.53 (SD 0.76) hours training and 0.27 (SD 0.09) hours in competition. Table 1 shows information about characteristics of injuries in total population.

Global injury rate was 3.86 /1000h exposure. In the subgroup analysis, males showed higher incidence than females (4.16/1000 h exposure and 3.04 /1000 h exposure respectively). Injury rate was 11.7 times higher in competition (29.14 injuries /1000h exposure) than during practices (2.49 injuries/1000 h exposure).

Global mean time loss was 7.52 (SD 11.28) sessions. Figure 2 represents mean time loss by gender and time of activity. By location, wrist injuries had the largest mean time loss (14.5 mean sessions lost, SD 13.43) followed by knee injuries (14.29, SD 28.34) and calf (10.2, SD 10.15) ($p=0.26$). By type of injury the largest mean time loss was ligament tear which conducted to the end of the season in two cases. Both cases were anterior cruciate ligament tears. Following type of injuries with largest mean time loss were meniscal / cartilage tear (108, SD 0) and fractures (22.67, SD 21.93) ($p=0.02$). A total of 8 fractures were counted during the study. 2 (25%) were nasal bone fractures, 2 (25%) were rib fractures, 1 (12.5%) was a buckle fracture at distal radius and 3 (37.5%) were buckle fractures at hand phalanges.

Table 1. Main characteristics of injuries.

	%		%		%
Sex		**Type of injury**		**Location of injury**	
Male	79	Concussion	0.8	Head	0.8
Female	21	Fracture	6.5	Face	4.8
Side of injury		Dislocation	1.6	Ribs – chest	4
Right	41.3	Sprain	35.5	Lower back	8.9
Left	39.7	Ligamentous tear	1.6	Pelvis – sacrum	1.6
N/A	19	Meniscal / cartilage tear	1.6	Elbow	1.6
Player position		Tendinopathy	4	Wrist	1.6
Outsider	47.8	Muscle tear	12.9	Hand	1.6
Insider	25.2	Contusion	11.3	Finger	6.5
Mechanism		Bursitis/fasciitis	7.3	Thumb	2.4
Trauma w/o contact	30.6	Epidermal injury	2.4	Groin	4
Player contact	28.2	Muscle soreness	9.7	Thigh	7.3
Recurrent	9.7	Dental injury	0.8	Knee	13.7
Ball contact	9.7	Artritis	1.6	Calf	4
Static object contact	6.5	Other	2.4	Ankle	32.3
Other	15.3			Toe	4.8
Moment of season		**RTP**			
Preseason	18.5	Complete	72.7	**Type of activity**	
First season half	37.9	Partial individual	14.9	Training	61.3
Second season half	43.5	Partial collective	12.4	Competition	38.7

Abbreviations: N/A: Not Applicable; RTP: Return To Play; w/o: without.

Figure 2. Time loss.

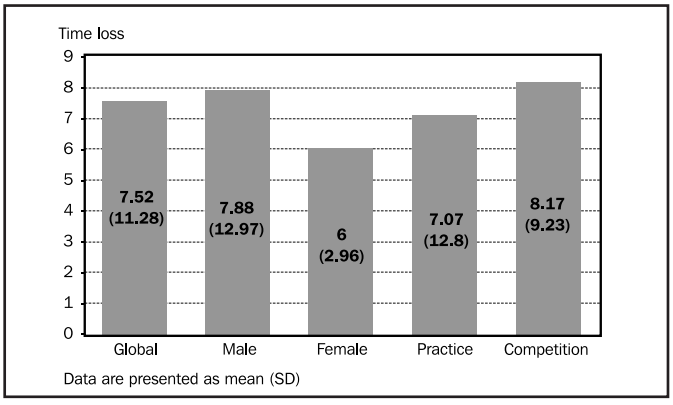


Table 2 and Table 3 shows injuries characteristics distributed by gender and type of activity.

Discussion

This study presents the epidemiology of injury in a Spanish basketball club entirely compound by adolescents and recreational players.

The incidence of injury was 3.86/1000 h exposure, similar than other registries, where injury rates vary from 3 to 9.8 injuries /1000 h[5,13,14], and lower in comparison with other contact sports like handball[15] or football[8], or even non-contact sports like volleyball[8]. However, comparing incidence of injury with other reports is not easy because it may be expressed in very different measure units like number of injuries / 1000 players[6], number of injuries / 1000 athletic exposures[9,10,16] or number of injuries / 1000 h exposure. Furthermore, several articles about basketball injuries are carried out in Emergency Departments[6,11,17], which provide very important information about characteristics of injuries but incidence cannot be calculated. The statement of universal measure units seems critical to obtain reliable information about incidence of injuries.

The ankle was the most frequent location of injury (32.3%), and sprains the most frequent diagnosis (35.5%) in the global analysis. These results are similar to previous reports, where ankle sprains represent 23-40% of all basketball injuries[18-21]. The knee was the second in the list (13.7%), and also the second in mean time loss (14.28; SD 28.34). It is remarkable the large SD compared to the mean time loss in knee injuries. This fact is due to the high variability of injuries that can occur at the knee, where very serious (ACL and meniscal tears) and mild injuries (Osgood-Schlatter disease) can coexist. Several articles show similar results than ours in terms of frequency of knee inuries[4,9,18] and importance[10,22]. We can assume that the knee is a very susceptible location for serious injuries in basketball, but an accurate diagnosis is required as it is a common location of banal injuries as well. The wrist was the location with largest mean time loss (14.5, SD13.43) because a buckle fracture which required splinting occurred here. However, it is not a common location of injury as only 2 injuries were registered here.

The influence of gender in injury rate in basketball is controversial. Most reports show, as we do, that males get injured more often than females with variable differences[19]. Dick *et al*[9] and Agel *et al*[10] registries about male and female injuries in fifteen consecutive National College Athletics Association league seasons showed an incidence of 9.9 and 4.3 injuries / 1000 athletic exposures in games and practice respectively for males *versus* 7.68 and 3.99 injuries / 1000 athletic exposures for females. On the other hand, Manonelles-Marqueta *et al*[21], Borowski *et al*[7] and Cumps *et al*[5] found that female injury rate was higher, with this

Table 2. Comparison of injuries distribution by gender.

	Male	Female	p		Male	Female	p
Age	17.4 (5.9)	17.4 (6.5)	0.67	**Location of injury**			
Type of injury				Head	1	0	
Concussion	1	0		Face	6.1	0	
Fracture	5.1	11.5		Ribs – chest	5.1	0	
Dislocation	2	0		Lower back	8.2	11.5	
Sprain	37.8	26.9		Pelvis – sacrum	2	0	
Ligamentous tear	1	3.8		Elbow	0	7.7	
Meniscal / cartilage tear	1	3.8		Wrist	1	3.8	
Tendinopathy	2	11.5	0.042	Hand	2	0	0.042
Muscle tear	14.3	7.7		Finger	3.1	19.2	
Contusion	13.3	3.8		Thumb	3.1	0	
Bursitis/fasciitis	7.1	7.7		Groin	3.1	7.7	
Epidermal injury	3	0		Thigh	7.1	7.7	
Muscle soreness	10.2	7.7		Knee	13.3	15.4	
Dental injury	1	0		Calf	5.1	0	
Artritis	0	7.7		Ankle	34.7	23.1	
Other	1	7.7		Toe	5.1	3.8	
RTP				**Type of activity**			
Complete	75.3	62.5	0.287	Training	57.1	76.9	0.066
Partial individual	12.4	25		Competition	42.9	23.1	
Partial collective	12.4	12.5		**Side of injury**			
Player position				Right	41.1	42.3	0.514
Outsider	73	80.8	0.424	Left	37.9	46.2	
Insider	27	19.2		N/A	21	11.5	
Mechanism				**Moment of season**			
Trauma w/o contact	33.7	19.2	0.009	Preseason	30.4	11.5	0.479
Player contact	31.6	15.4		First season half	35.7	46.2	
Recurrent	8.2	15.4		Second season half	43.9	42.3	
Ball contact	5.1	26.9					
Static object contact	7.1	3.8					
Other	14.3	19.2					

Data are presented as mean (SD) or %
Abbreviations: N/A: Not Applicable; RTP: Return To Play; w/o: without.

last study showing largest incidences than ours in both groups (11.1 female injuries /1000 h, 8.5 male injuries /1000 h). However, Rechel *et al*[16] reported that women got injured more often than males in competition (3.6 /1000 h *vs* 2.98 /1000 h) and men did during practice (1.37 /1000h *vs* 1.46/1000 h). A possible explanation for the difference of incidence we obtained between groups is that the women group was not as numerous as the men group, because the reduced number of female players that listed in the club.

The patterns of injury according to gender are not clear. Fractures comprise 15-16% of all injuries in basketball[8,17], and are more prone to happen in women in the upper limb, specially wrist and fingers. These findings were confirmed in our series. Manonelles-Marqueta *et al*[21] showed that ankle sprain was again the most common injury in professional female players, but it frequency was significantly lower than in our series (11.7% *vs.* 23.1%) and other reports, followed closely by patellar tendinopathy or condropathy (11.03%). In contrast, we found that the knee was only the third most common location of injury in females (15.4%), with finger injuries (19.2%) in second place. The size of our sample was not big enough to make conclusions about the influence of gender in anterior cruciate ligament tears rates. Mihata *et al*[23] found that anterior cruciate ligament tear incidence was almost three times greater in female basketball players. Concussions were only present in men, while Noble *et al*[24] reported than females' rate was noticeably higher (4.8- 6.1 /1000 athletic exposures *vs* 3.4- 3.5 /1000 athletic exposures). The differences in group sizes could again explain this fact.

Incidence of injury was remarkably higher during competition than during training. This trend is attributed to the higher intensity during a competitive match. The influence of external agents like playing in different surfaces when playing as visitors has to be pointed out in recreational players. This difference in injury rates has already been described in basketball[10,11,25] and in other contact sports[8,26]. However, the competition- practice incidence of injury ratio we obtained was larger than others reports (11.7:1 *vs* 2-9.4:1). In contrast, Barber Foss *et al*[8] found that incidence during practice was 7.4 higher in volleyball players. Although volleyball and basketball could be comparable as both sports imply continuous changes of direction and jumping, it seems clear that physical contact between players is a major factor in development of injuries in basketball.

During games, acute injuries were predominant, while overload injuries were during practice. Contusions were almost three times more

Table 3. Comparison of injuries distributed by type of activity.

	Training	Competition	p		Training	Competition	p
Age	17.1 (5.1)	18 (7.1)	0.97	**Location of injury**			
Type of injury				Head	0	2.1	
Concussion	0	2.1		Face	3.9	6.2	
Fracture	6.6	6.2		Ribs – chest	2.6	6.2	
Dislocation	0	4.2		Lower back	13.2	2.1	
Sprain	43.4	22.9		Pelvis – sacrum	2.6	0	
Ligamentous tear	0	4.2		Elbow	0	4.2	
Meniscal / cartilage tear	1.3	2.1		Wrist	1.3	2.1	
Tendinopathy	6.6	0	0.01	Hand	0	4.2	0.046
Muscle tear	9.2	18.8		Finger	6.6	6.2	
Contusion	6.6	18.8		Thumb	2.6	2.1	
Bursitis/fasciitis	9.2	4.2		Groin	3.9	4.2	
Epidermal injury	1.3	4.2		Thigh	6.6	8.3	
Muscle soreness	13.2	4.2		Knee	13.2	14.6	
Dental injury	0	2.1		Calf	0	10.4	
Artritis	2.6	0		Ankle	36.8	25	
Other	0	6.2		Toe	6.6	2.1	
RTP				**Side of injury**			
Complete	73.7	71.1		Right	41.9	40.4	
Partial individual	18.4	8.9	0.08	Left	37.8	42.6	0.84
Partial collective	7.9	20		N/A	20.3	17	
Mechanism				**Moment of season**			
Trauma w/o contact	27.6	35.4		Preseason	21.1	14.6	
Player contact	23.7	2.1		First season half	34.2	43.8	0.49
Recurrent	14.5	35.4		Second season half	44.7	41.7	
Ball contact	9.2	10.4	0.17	**Player position**			
Static object contact	7.9	4.2		Outsider	74.6	75	0.42
Other	17.1	12.5		Insider	25.4	25	

Data are presented as mean (SD) or %
Abbreviations: N/A: Not Applicable; RTP: Return To Play; w/o: without.

frequent during competition than during practices. Therefore, common contusion locations, like head, face and ribs – chest presented higher injury rates in games with statistical significance. On the other hand, typical overload diagnosis like bursitis, tendinopathy and muscle soreness where more frequent during training, and preferable locations where knee and lower back.

The influence of the type of activity in the severity of injuries in basketball remains controversial. Although a direct relationship between intensity of the play and seriousness of injury could be established reasonably, injury rates seem to be almost identical in competition and in practice[9,10] or statistical significance has not been obtained[19]. Competition injuries meant largest mean time loss in our register but differences were not statistically significant.

Our study presents several limitations. The first one is the definition of injury as any harm that result in inability to play. Any health issue that limited physical performance but did not imply missing a game or practice was not considered an injury. This could drive to an underestimation of the incidence of injuries. However, we think that this underestimation could be limited by the fact that the absence during a session due to body harm is higher in recreational players, who are not forced to play for financial reasons. Furthermore, most of reports used the same definition of injury[7,9,10]. Another limitation was that the club did not have economical support to sustain assistance to injured players, so the costs of the treatments were carried out by the federative insurances and, many times, by the own player. This fact probably contributed to increase time loss as individual recovery programs could not be developed in the club structure. As commented before, the different sizes of gender groups difficult comparison of results.

Conclusions

The incidence of injury was 3.86/1000 h exposure, lower than other contact sports. Men presented higher injury rate than females (4.16/1000 h exposure *vs*. 3.04 /1000h exposure). Incidence of injury during competition was 11.7 times higher than during practice. Ankle sprain was the most frequent injury independently of gender and type of activity. Women were more prone to upper limb injuries and fractures, while men had longer time loss. Contusions were almost three times more common during competition than during practices, while overload injuries like bursitis, tendinopathy and muscle soreness appeared significantly more during practices.

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Índice

Cardiorespiratory capacity and body composition in girls and adolescents practitioners of Rhythmic Gymnastics

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Summary

Introduction: Aerobic capacity is one of the qualities to be developed in rhythmic gymnastics sport which requires huge physical and technical demands, with high loads of training.
Objective: To analyze cardiorespiratory capacity and VO_2max and its relation to body composition: body mass index (BMI), fat percentage, waist circumference in girls and adolescents practicing rhythmic gymnastics
Method: Descriptive, comparative, cross-sectional study involving 116 competition gymnasts between 8 and 17 years old (48.3% were girls and 51.7% were adolescents). For the evaluation of the cardiorespiratory ftness, the Navette Course test was applied, calculating the VO_2max with the results obtained. Body weight, height, waist circumference, sub-scapular folds and triceps were measured. The body mass index (BMI) was calculated with weight and height, with the measures of the folds the percentage of fat and with the waist circumference the waist height ratio (WHR).
Results: 13.8%, and 23.3% of the total sample showed very high aerobic capacity, and high respectively. Significant differences were found between the two age groups for the Course-Navette test (U = 1214.0 p =.009 r = 2.60) and for VO_2max (U = 300.0 p =.000 r = 7.60). The adolescents gymnasts presented greater aerobic capacity than the girls. Adolescents showed a correlation with BMI (p =.006) and weight (p=.014). The gymnasts showed a WHR lower than 0.55, all factors related to a better cardiovascular profile
Conclusions: Gymnasts in general have good aerobic capacity. The Adolecents showed higher levels of aerobic capacity than girls. All have a BMI, waist circumference and fat percentage below the referenced values.

Key words:
Cardiovascular capacity. VO_2max. Body mass index. Fat percentage. Rhythmic gymnastic.

Capacidad cardiorrespiratoria y composición corporal en niñas y adolescentes practicantes de gimnasia rítmica

Resumen

Introducción: La capacidad aeróbica es una de las cualidades a desarrollar en gimnasia rítmica, deporte que requiere grandes exigencias físicas y técnicas, con elevadas cargas de entrenamiento.
Objetivo: Analizar la capacidad cardiorrespiratoria y el VO_2Max y su relación con la composición corporal: índice de masa corporal (IMC), porcentaje graso, perímetro de cintura en niñas y adolescentes practicantes de gimnasia rítmica.
Método: Estudio descriptivo, comparativo, de corte transversal donde participaron 116 gimnastas de competición entre 8 y 17 años (el 48,3% eran niñas y 51,7 % adolescentes). Para la evaluación de la capacidad cardiorrespiratoria se aplicó el test Course Navette calculándose el VO_2max con los resultados obtenidos. Para la composición corporal se midió el peso, altura, perímetro de cintura, pliegues sub-escapular y tríceps. Con el peso y la altura se calculó el índice de masa corporal, con las medidas de los pliegues el porcentaje de grasa y con el perímetro de cintura la razón cintura estatura (RCE).
Resultados: El 13,8%, y 23,3% de la muestra total mostraron una capacidad aeróbica muy alta, y alta respectivamente. Se encontró diferencias significativas entre los dos grupos de edad para el test Course-Navette (U = 1.214,0 p = 0,009, r = 2,60) y para el VO_2max (U = 300,0 p = 0,000, r = 7,60). Las gimnastas adolescentes presentaron mayor capacidad aeróbica que las niñas. Las adolescentes mostraron una correlación con el IMC (p = 0,006) y el peso (p = ,014). Todas mostraron un RCE menor que 0,55, factores todos relacionados con un mejor perfil cardiovascular.
Conclusiones: Las gimnastas en general presentan buena capacidad aeróbica. Las adolescentes mostraron mayores niveles de capacidad aeróbica que las niñas. Todas tienen un IMC, perímetro de cintura y porcentaje graso por debajo de los valores referenciados.

Palabras clave:
Capacidad cardiovascular. VO_2max. Índice de masa corporal. Porcentaje graso. Gimnasia rítmica.

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Introduction

Aerobic capacity is one of the main health-related components of physical fitness[1] and is key to sports activities.

Rhythmic gymnastics is a highly taxing sport, both physically and technically, which calls for a high level of training[2]. It is, therefore, imperative for gymnasts to be healthy and in optimum overall physical shape in order to pursue it.

For Douda *et al*.,[3] anthropometric characteristics and aerobic capacity are, alongside flexibility and explosive strength, significant determinants of successful performance for these gymnasts.

Several studies have shown that cardiorespiratory fitness is the strongest predictor of mortality and morbidity[4]. It has also been demonstrated that low cardiorespiratory capacity represents the most important cardiovascular risk factor, even surpassing such classics as excess weight or obesity[5].

There exists evidence of a direct relationship between low cardiorespiratory capacity in childhood and adolescence, and an increased risk of cardiovascular diseases in later life[5-8].

Hence the growing interest in improving the cardiovascular fitness of the school population in recent years[9-11]. Numerous studies have found a relationship between levels of cardiorespiratory fitness and different components of physical fitness: body composition, muscular strength, flexibility, speed-agility and coordination[12.13].

Many of these studies also indicate that a build-up of fat in the abdominal region would also appear to be a contributory factor for possible cardiovascular diseases[14.15].

However, few studies have been conducted with gymnasts specializing in this sport[2,3].

The aim of this study, therefore, was to analyse the cardiorespiratory capacity and VO_2max of pre-adolescent and adolescent rhythmic gymnasts and see their relationship with body composition: body mass index and fat percentage.

Material and method

Subjects

A total of 116 female competition gymnasts belonging to 5 clubs in 4 provinces of Andalucía who took part in the 2015 national championship were selected intentionally. 48.3% were pre-adolescents between 8 and 12 years of age, and 51.7% were adolescents of between 13 and 17. They all participated on a voluntary basis with the informed consent of their parents in accordance with the Declaration of Helsinki on ethical principles for research and following current Spanish legislation regulating medical research involving human subjects (Royal Decree 561/1993 on clinical trials).

Procedure

First of all, we spoke with the coaches and parents at the different clubs to inform them about the objective of the study and ask them for their informed consent.

The authors of the work then went to different provinces of Andalucía: Granada, Málaga, Seville and Huelva. The tests were conducted at each gymnast's training facility. Before starting the training session, body composition measurements were taken in the following order: height, weight, waist circumference and subscapular and triceps skinfolds of all the gymnasts. The protocol established by the International Society for the Advancement of Kinanthropometry was followed for all the measurements taken[16]. The body mass or Quetelet index (kg/m^2) was calculated with the weight and height. Because our populations consisted of pre-adolescent - adolescent girls, we used the indicators proposed by Pan and Cole, cited in Cole *et al*. [17]: grade 3 thinness (<16); grade 2 thinness (16.1 to 17); grade 1 thinness (17.1 to 18.5); normal (18.5 to 24.9); overweight (25 to 30); and obesity (≥30). The skinfold measurements (triceps and subscapular) were used to calculate the body fat percentage by application of the formula associated with the *ALPHA-Fitness* test battery. The subjects' waist-to-height ratios (WHtR), obtained by dividing waist circumference by height, both in centimetres, were used as an indication of the build-up of body fat in the central part of the body, a ratio of 0.55 or higher indicating greater cardiometabolic risk (CMR)[18]. The following instruments were used to take the measurements: SECA 861 electronic scales (range: 0.05 to 130 kg; accuracy: 0.05 kg) for weight; a SECA 220 measuring rod with an accuracy of 1 mm for height; Holtain callipers with a constant pressure of 10 g/mm^2 on the contact surface for triceps and subscapular skinfolds; and a non-elastic SECA 200 tape measure (range: 0 to 150 cm; accuracy: 1 mm) for waist circumference.

Subsequently, before the end of the training session, the subjects' aerobic capacity was tested using the multi-stage fitness test, a progressive, indirect test consisting of 20-m. shuttle runs starting at a speed of 8.0 km/h.

Each gymnast was allowed only one attempt. The last level completed was registered for subsequent statistical analysis.

Maximal oxygen uptake (VO_2max) was calculated with the results obtained from this test by applying the following equation: $VO_2max = 31.025 + 3.238 (V) - 3.248 (A) + 0.1536 (AV)$, where V is speed reached in the last level of the multi-stage fitness test in km•h^{-1} and A is age in years. The validity and reliability of this equation to estimate VO_2max in children and adolescents has been widely demonstrated[19].

The measurements were taken by visiting the different clubs in the afternoon training period during the preparatory period of the 2015 annual training plan, in the introductory mesocycle.

Statistical analysis

The normality and homoscedasticity of the distributions were obtained through the Kolmogorov-Smirnov test and Levene's test, respectively. On failing to observe a normal distribution of the aerobic capacity values recorded (multi-stage fitness test) according to the different levels of the age variable, it was decided that nonparametric analysis should be performed. Independent samples were contrasted using the Mann-Whitney U test. The effect size (r) was calculated by applying the formula $Z\sqrt{N}$ (Z by square root of N). Rank correlation was

analysed using Spearman's rho. The data are given in mean ranks. All the forms of analysis were performed using SPSS v 22.0 (SPSS Inc. Chicago IL USA) and the level of significance was 5%.

Results

Table 1 shows the descriptive data of all the variables of the gymnasts who participated in the study which were analysed.

The Pan & Cole Index was calculated according to the composition of the sample (Table 2).

Table 3 shows aerobic capacity for the values of VO_2max recorded by the gymnasts, divided into average, good and excellent according to García-Manso *et al.*, cited in Corral *et al*[20].

The Mann-Whitney U test revealed the presence of statistically significant differences in aerobic capacity between the two age groups considered, U = 1,214.0 p = 0.009, r = 2.60. Similarly, a statistically significant difference was found between the age groups and the maximum volume of oxygen (U = 300.0 p = 0.000, r = 7.60). To be more specific, the adolescent gymnasts gave higher values than the pre-adolescent ones.

Table 1. Anthropometric characteristics of the gymnasts by age group.

	Age (years)		
	8-12 y.o. (n = 56)	13-17 y.o. (n = 60)	Total (n = 116)
Weight (kg)	30.02 (6.11)	44.7 (6.72)	37.64 (9.64)
Height (m)	1.35 (0.17)	1.55 (0.71)	1.45 (0.13)
BMI (kg/m^{-2})	16.20 (1.67)	18.37 (1.68)	17.32 (2.07)
Waist circumference (cm)	56.64 (3.30)	64.96 (1.86)	60.94 (4.94)
Subscapular skinfold (mm)	10.25 (2.43)	9.98 (1.77)	10.11 (2.11)
Triceps skinfold (mm)	8.28 (2.12)	11.9 (2.06)	10.15 (2.76)
Body fat percentage (%)	14.48 (3.13)	20.23 (2.51)	18.91 (3.13)
WHtR (cm)	0.419 (0.03)	0.418 (0.01)	0.419 (0.03)
Multi-stage fitness test (*stage*)	3.45 (1.35)	4.36 (1.13)	3.72 (1.27)
VO_2max (ml/(kg min))	39.11 (3.37)	45.21 (3.23)	42.51 (4.47)

The data are given as mean values (standard deviation).

Table 2. Frequency (and percentage) of the Pan & Cole Index, according to the composition of the sample.

	Age (years)		
	≤ 12 y.o. (n = 56)	≥ 13 y.o. (n = 60)	Total (n = 116)
Pan & Cole Index			
Thinness (Grade 1)	27 (48.21%)	22 (36.6%)	49 (42.24%)
Thinness (Grade 2)	8 (14.3%)	8 (13.3%)	16 (13.8%)
Normal	21 (37.5%)	30 (50%)	34 (43.96%)

Table 3. Frequency (and percentage) of aerobic capacity for VO_2max. values expressed in ml.kg.min.[20]

Age (years)	Average (31-37 ml.kg.min)	Good (38-48 ml.kg.min)	Excellent (> 48 ml.kg.min)
≤ 12	16 (26.7%)	44 (73.3%)	
≥ 13		43 (76.8%)	13 (23.2%)
Total	16 (13.8%)	87 (75%)	13 (11.2%)

Table 4. Level of aerobic capacity according to the Multi-stage fitness test using reference values.[21]

Aerobic capacity	Age (years) 8-12 (n=56)	13-17 (n=60)	Total (n=116)
Very low	9 (16.07%)		9 (7.76%)
Low	22 (39.28%)	10 (16.66%)	32 (27.58%)
Average	8 (14.28%)	24 (40.00%)	32 (27.58%)
High	11 (19.64%)	16 (26.67%)	27 (23.28%)
Very high	6 (10.71%)	10 (16.67%)	16 (13.79%)

The data are presented as frequencies (percentage).

Table 4 shows the level of aerobic capacity according to the multi-stage fitness test using the reference values[21], dividing them into very low, low, average, high and very high.

Table 5 shows the results of correlation analysis between the different variables according to the different age groups using Spearman's rho. Considering the sample as a whole, the correlation study reveals a statistically significant correlation (p <0.05 y p <0.01) between the variables weight, height, BMI, waist circumference, body fat percentage and VO_2max.

Discussion

The principal findings of the study showed that adolescent gymnasts are more aerobically fit than younger gymnasts. They all had low BMI, waist circumference and body fat percentage values, these being more pronounced in the pre-adolescent gymnasts. Correlations were found between weight, height, BMI, waist circumference, body fat percentage and VO_2max. WHtR was lower than 0.55 in both age groups.

The percentages of very high, high and average cardiorespiratory capacity scores obtained by the gymnasts were 10.7%, 19.6% and 14.2% for the pre-adolescents, and 16.6%, 26.7% and 40% for the adolescents[21].

Contrasting these data with normal populations in the same age range, it was found that the pre-adolescent gymnasts registered a mean value of 3.45 in the multi-stage fitness test, slightly higher than pre-adolescents between 8 and 11 years of age[22,23], who have values of 2.9 and 3, respectively. Meanwhile, the adolescent gymnasts obtained results slightly higher than those reported by Cuenca *et al.*[8], and Delgado *et al.*[23], with values of 3.84 and 4.

Table 5. Correlation analysis by age group. Spearman's rho.

		Weight	Height	BMI	Waist circumference	Body fat percentage	Multi-stage fitness test	VO_2max
Weight	Rho de Spearman		0.716**	0.805**	0.646**	0.284*	-0.070	-0.316*
	Sig. (2-tailed)		0.000	0.000	0.000	0.028	0.596	0.014
	N		60	60	60	60	60	60
Height	Rho de Spearman	0.807**		0.223	0.362**	0.012	0.005	-0.183
	Sig. (2-tailed)	0.000		0.087	0.004	0.928	0.967	0.162
	N	56		60	60	60	60	60
BMI	Rho de Spearman	0.642**	0.106		0.598**	0.384	-0.150	-0.354**
	Sig. (2-tailed)	0.000	0.438		0.000	0.002	0.254	0.006
	N	56	56		60	60	60	60
Waist circumference	Rho de Spearman	0.360**	0.189	0.403**		0.246	0.142	-0.048
	Sig. (2-tailed)	0.006	0.164	0.002		0.058	0.278	0.714
	N	56	56	56		60	60	60
Body fat percentage	Rho de Spearman	-0.074	0.068	-0.171	0.078		0.230	0.136
	Sig. (2-tailed)	0.558	0.616	0.208	0.568		0.077	0.300
	N	56	56	56	56		60	60
Multi-stage fitness test	Rho de Spearman	0.419**	0.471**	0.082	0.069	0.142		0.868**
	Sig. (2-tailed)	0.001	0.000	0.549	0.612	0.297		0.000
	N	56	56	56	56	56		60
Vo_2max	Rho de Spearman	0.109	0.217	-0.100	-0.169	0.067	0.808**	
	Sig. (2-tailed)	442	0.108	0.462	0.214	0.624	0.000	
	N	56	56	56	56	56	56	

**The correlation is significant at the 0.01 level (2-tailed). *The correlation is significant at the 0.05 level (2-tailed)

Age group: Adolescents (≥13 y.o.) Age Group: pre-adolescents (≤12 y.o.)

As for VO_2max, the adolescent gymnasts gave slightly higher percentages (45.21 (±3.23) ml/(kg min)) compared to the percentages from Spanish studies carried out on populations in a similar age range suggested by other authors[6,23,24]. The total sample had average, good and excellent VO_2max values (13.8%, 75% and 11.2%) according to the reference values[20] (Table 3).

Adding these percentages together, 44.6% of the pre-adolescent girls and 63.4% of the adolescents had healthy levels. These values are lower than those found for Spanish adolescent girls, 82.7%[25], but higher than the 53% of Portuguese girls26 aged from 10 to 18.

On comparing our results with the referential values of the ALPHA battery[21], we note that most of the gymnasts aged between 13 and 17 years gave average, high and very high values in terms of aerobic capacity, but that the pre-adolescent girls did not (Table 4).

In fact, significant differences existed between the two age groups, the adolescent gymnasts showing greater aerobic capacity (U = 1,214.0, p = 0.009, r = 2.60) and VO_2max (U = 300.0 p = 0.000, r = 7.60) than the pre-adolescents.

In the ≥13 age group, the sum of the very high and high aerobic capacity percentages exceeded the average percentages, no gymnast giving very low results in the test. However, in the ≤12 group, the percentage of high and very high aerobic capacity was lower than the average, with 16.07% and 39.28% of the sample giving values categorised as very low and low[21] (Table 4). These results do not support the relationship found by Tomkinson *et al.*[27] between an increase in age and a decrease in aerobic capacity in the normal population. After conducting a meta-analysis with 55 reports studying the trend of cardiovascular fitness (multi-stage fitness test) in children and adolescents from 1980 to 2000, these authors affirmed that aerobic capacity declines as students grow, pointing to a 0.41% drop in aerobic fitness per year for girls, with a much more marked decline in adolescents than in children. Malina[28] reports similar results for the American population. These trends are not observed in this study. Adolescent gymnasts do a greater volume of physical activity than the normal population due to the training they carry out, thereby exercising and enhancing this variable. There exist studies which describe the importance of physical activity and its influence on this characteristic[29,30].

In the ≤12 group, however, low and very low aerobic capacity results are observed. Being gymnasts in younger categories, the competitive level required of them is lower and so their training loads are lighter, allowing us to imagine that the aerobic work they perform is less specific

than that of the adolescents. Studies show that the effects of training depend specifically on the exercises done[30].

With regard to the body composition variables, the average BMI was 17.32 kg.m^{-2}, most of the gymnasts having normal or slightly low weights; "Grade 1 thinness" (Tables 1 and 2) according to the values of Cole *et al*[17]. These results are similar to those reported in studies with rhythmic gymnasts by Di Cagno *et al.*[31] and Vernetta *et al.*[32], but lower than the results obtained by Avila-Carvalho *et al.*[33], 18.75 kg/m^2, and Rutkauskaitė *et al.*[2], 18.5 kg/m^2, and slightly higher than the 16.9 kg/m^2 registered by Soric *et al.*[34] and the 16.82 kg/m^2 recorded by Poliszczuk *et al*[35].

No significant differences were found between groups of pre-adolescents and adolescents with regard to the categorisation of BMI. However, there is a greater percentage of adolescent gymnasts with a normal BMI and a higher percentage of pre-adolescent gymnasts with Grade 1 thinness (Table 2).

Similarly, the mean waist circumference in the total sample was 60.94 cm, this value being lower than those of Avila-Carvalho *et al.*[33] and D'Alessandro *et al.*[36], with 67.05 cm and 66.8 cm respectively, and very similar to the 58.66 cm found in Roman *et al*[37].

As for body fat percentage, most of the gymnasts were in the middle and low percentiles according to the reference values[21]. They also gave low BMI values, coinciding with other studies[3,31,33,38].

In general, the lower BMI and waist circumference results of these gymnasts compared to the normal population is correlated with the importance that these athletes give to their weight as part of their body image, rhythmic gymnastics being an aesthetic sport where thinness and good presence are important factors when it comes to succeeding and winning[32,39].

Regarding the association between the multi-stage fitness test and VO_2max (Table 5), the existence of a positive relationship between the test and the VO_2max ($p = 0.000$) calculation was found for the total sample. Meanwhile, a negative relationship was found between the VO_2max, BMI ($p = 0.006$) and weight ($p = 0.014$) values in the adolescent gymnasts. However, no statistically significant relationship was found between aerobic capacity and the other anthropometric variables (weight, height, BMI, body fat percentage and waist circumference) paired independently with each of the age groups.

The data obtained from our adolescent gymnasts do not substantiate the relationship between performance in the aerobic multi-stage fitness test and BMI shown in the child-adolescent population[40,41]. The fact that our gymnasts have good aerobic capacity and a BMI at or slightly below normal weight in both groups may be why no relationship can be found like that in studies which report an inverse relationship between nutritional status or levels of body fat and aerobic capacity in overweight and obese girls[40].

However, significant relationships have been discovered between maximum oxygen volume, BMI and weight in the adolescents. The relationship is inverse, i.e. the greater the VO_2max, the lower the Body Mass Index and weight. These results resemble those reported by other authors[7,15,41], who showed that children and adolescents with a lower BMI had greater VO_2max compared to those who were overweight/obese. Similarly, Ross *et al.*[42] report that high cardiorespiratory capacity is associated with lower BMI, while Ara *et al.*[43] describe how active children who are more aerobically fit accumulate less fat during growth both all over the body and in the trunk region.

In our study, all the gymnasts had a low body fat percentage, waist circumference and BMI, and a WHtR of less than 0.55, all factors related to a better cardiovascular profile[7,44].

In conclusion, the results of this study show that, in general, the gymnasts had good aerobic capacity when held up against the standard reference values. The adolescent gymnasts had higher aerobic capacities and VO_2max than the pre-adolescents. They all had low BMIs, waist circumferences and body fat percentages. A relationship existed between the VO_2max, BMI and weight of the adolescent girls.

In terms of practical application, we can say that in this discipline, which requires early initiation, the evaluation of aerobic capacity as a physical health-related characteristic should be considered a fundamental tool when it comes to identifying fitness and controlling training properly. Aerobic capacity should be worked on at every stage of training, with a special emphasis on the preparatory period, where developing good aerobic capacity is essential to achieving the sport's specific performance objectives. The high percentage of adolescent gymnasts with good aerobic capacity shows that they are specifically working on this variable with some success. However, the percentage of pre-adolescent gymnasts with a low and very low aerobic capacity highlights the need for improvement by including specific aerobic exercises in their training microcycles.

Finally, in terms of limitations, our data cannot be extrapolated beyond the ranges observed in the study sample. It would, therefore, be good to increase and vary the sample of participants by applying this battery in other Spanish communities. Similarly, considering that gymnasts start rhythmic gymnastics at a young age, other age bands, including younger gymnasts who are just starting and gymnasts at different levels of competition, could be considered. It is also important to understand that the interpretation is based on the measurements taken compared with the reference values established for the non-athlete school population. Consequently, "high" and "very high" AC values may have been obtained with the adolescent gymnasts as a result of using these tables.

Looking ahead, it would be interesting to conduct longitudinal follow-up research on the VO_2max needs required over gymnasts' sporting careers and potential variations in aerobic capacity over a training macrocycle in order to establish specific reference values for this gymnastic discipline.

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Isokinetic performance of knee extensor and flexor musculature in adolescent female handball players

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Summary

Background: Handball is a sport that requires an extensive variety of movements and has led to an increased incidence of ankle and knee injuries. Specifically, to knee joint, detection and reduction in muscular deficits can help prevent injuries and improve muscular performance. Isokinetic dynamometer is a highly effective and trustworthy assessment tool for such detections. Therefore, *the objective* of this study was to analyze muscular performance, and the differences between dominant and non-dominant limb of the knee extensors and flexors in adolescent handball athletes.
Method: Data of isokinetic evaluation of knee muscles of 19 female handball players was obtained from a database and analyzed. The isokinetic dynamometer was used in a concentric-concentric mode for the knee extensors and flexors at angular velocities of 60°/s, 120°/s, 180°/s and 240°/s.
Results: Mean values of peak torque or the flexor/extensor ratio were not statistically significant in the comparison between the limbs at any of the angular velocities. Furthermore, the flexor/extensor ratio values were between 50% and 80% that are described as normal in the literature of knee joint.
Conclusions: This study demonstrated that lower-limb dominance does not interfere in the muscular concentric isokinetic performance of the knee extensor and flexor muscles in adolescent handball athletes. Consequently, it can be suggested that handball athletes present lower risk of knee injuries when compared to sports that lead to some type of muscular asymmetries.

Key words:
Handball. Knee. Muscle strength.

Valoración isocinética de la musculatura extensora y flexora de la rodilla de jugadoras de balonmano adolescentes

Resumen

Introducción: El balonmano es un deporte que requiere una gran variedad de movimientos; en consecuencia, se ha demostrado que aumenta la incidencia de lesiones en el tobillo y la rodilla. Específicamente, para la articulación de la rodilla, la identificación y reducción de los déficits musculares pueden ayudar a prevenir lesiones y mejorar el rendimiento muscular. El dinamómetro isocinético es un método de evaluación de alta efectividad y confiabilidad para este tipo de identificación. Por lo tanto, *el objetivo* de este estudio fue analizar el rendimiento muscular y las diferencias entre los miembros dominantes y no dominantes de los extensores y flexores de la rodilla de jugadores de balonmano adolescentes.
Métodos: Se obtuvieron datos sobre la evaluación isocinética de los músculos de la rodilla de 19 jugadores de balonmano femenino. El dinamómetro isocinético se utilizó en modo concéntrico-concéntrico para los músculos extensores y flexores de la rodilla en las velocidades angulares de 60°/s, 120°/s, 180°/s y 240°/s.
Resultados: Tanto los valores medios del pico de torque como la relación flexores/extensores no fueron estadísticamente significativos entre los miembros en ninguna de las velocidades angulares. Además, la relación flexores/extensores estaban entre el 50 y el 80% que se describen como normales en la literatura para la articulación de la rodilla.
Conclusiones: Este estudio demostró que el dominio de los miembros inferiores no interfiere con el desempeño concéntrico isocinético de los músculos extensores y flexores de la rodilla en adolescentes practicantes de balonmano. En consecuencia, se puede sugerir que los atletas de balonmano tienen un menor riesgo de padecer lesiones de rodilla en comparación con los practicantes de otros deportes que causan algún tipo de desequilibrio muscular.

Palabras clave:
Balonmano. Rodilla. Fuerza muscular.

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Introduction

Handball is a sport that requires an extensive number and variety of movements; jumps, settings, accelerations, changes of direction, and passing are the most frequent gestures of this sport[1-5]. As a consequence of these characteristics, some epidemiological studies demonstrate that handball has an increased incidence of musculoskeletal injuries[6-9] and the ankle and knee joints are the most affected areas[7,9-14]. This increased incidence has also been documented in young female athletes[14-15]. Due to the physical consequences, and the long period away from the sport, the knee injuries have been in the spotlight in recent years, especially the anterior cruciate ligament (ACL) injuries[16]. According to Lohmande *et al.*[17], there is an increased incidence of ACL injuries in adolescent athletes from sports that involve the pivot movement such as in handball and the female athletes present an even higher risk[18].

Thus, assessing, identifying and reducing muscular deficits in the knees can help to prevent injuries[7,11,15,19], to improve muscular performance and to improve sporting gestures in handball athletes[1,5,20]. An important tool for this kind of identification is the isokinetic dynamometer, an assessment method that is highly effective and reliable[21]. Although, several studies have used the isokinetic assessment for muscular analysis in different sporting populations and joints, only a few studies have focused on its use for knee joint assessment of handball athletes[22-27], while none of them focused on adolescent female handball athletes. Therefore, the purpose of this study was to analyze, through information from a database, the muscular performance and differences between the dominant and non-dominant limbs of the knee extensor and flexor musculature in adolescent female handball players.

Material and method

This is a quantitative, cross-sectional and retrospective study conducted at the Instituto de Medicina do Esporte e Ciências Aplicadas ao Movimento Humano da Universidade de Caxias do Sul (IME-UCS) in the city of Caxias do Sul, Rio Grande do Sul, Brazil. It has been approved (protocol number 967.527) by the Ethical Research Committee of the Faculdade Cenecista Bento Gonçalves (Bento Gonçalves, Rio Grande do Sul, Brazil), and conducted according to the 2012 Law N° 466 of the National Health Council, which approves the guidelines and rules for research involving human beings.

For this study, the IME-UCS' database was used to obtain information regarding the concentric isokinetic evaluation of the knee extensor and flexor muscles. The study sample included 19 adolescent female handball players from the Universidade de Caxias do Sul team who were under age 16 and under age 18 categories. The number of participants was conveniently established and, therefore, determined intentionally and not by probability according to the number of available evaluations in the IME-UCS's database. The evaluations in which the respective IME-UCS consent term had not been authorized by the athletes and their responsible were excluded from this study. Athletes had a mean training experience of 5.38 years (±6.82), mean age of 15.37 years (±1.83), mean height of 1.67 meters (±0.09), mean weight of 61.41 kilograms (±9.68) and a mean body mass index (BMI) of 21.89 kg/m^2 (±2.31), which is considered normal[28]. The players self-reported their preferred upper limb for throwing a ball as their dominant upper limb and their preferred lower limb for kicking a ball as their dominant lower limb. All the 19 athletes reported the right upper and lower limb as their dominant limb (DL) and their left upper and lower limb as their non-dominant limb (NDL).

The evaluations data in the IME-UCS' database was collected using the isokinetic dynamometer (Biodex System 4®, Biodex Medical Systems, Shieley, New York, USA). The athletes first underwent warmup exercises on a stationary bicycle for 8 minutes at moderate velocity (70–80 rounds per minute) and then were led through the isokinetic dynamometer. Subsequently, they sat on the dynamometer chair with their torsos leaning at 85° with the motor axis aligned to the knee joint axis. They were stabilized with belts around the torso, pelvis, and thigh (1/3 distal) to avoid compensatory movements. Tests were first performed on the DL and next on the NDL. The range of motion for testing was set from 10 to 90° of knee flexion, where 0° is the full knee extension. The athletes performed three sub-maximal repetitions and a previous maximal for each test on all four velocities to familiarize themselves with the procedures and warmup. Protocol during the test demanded 5 maximal repetitions of knee extension and flexion in concentric-concentric mode on an angular velocity of 60°/s, 10 for the 120°/s, 15 for the 180°/s, and 20 for the 240°/s. A 1-minute rest period was set between evaluations of different velocities, and a 3-minute rest period between DL and NDL evaluations. Athletes were tested by the same examiner with the use of verbal incentives to stimulate and encourage them to use their maximum strength potential throughout the process.

Isokinetic variables – peak torque (PT, N/m) and the flexor/extensor ratio (%) – were used for the analysis. The flexor/extensor ratio is calculated from the PT value of the flexors divided by the PT value of the extensors. The mean values for PT and the flexor/extensor ratio of the knee joint musculature were evaluated statistically using the SPSS 17.0 software (Statistical Package to Social Science for Windows). To verify the normality of the data distribution, the Shapiro-Wilk test was used, and the mean values for the DL and NDL evaluations were submitted to the Student's T-test at a significance level of 0.05.

Results

We accessed isokinetic evaluations from 19 adolescent female handball players. The concentric isokinetic data results (PT of the DL and NDL) are presented in Table 1. At an angular velocity of 60°/s, 120°/s, 180°/s, and 240°/s, the average values for PT knee extensor and flexor muscles showed no significant differences between the limbs.

Table 2 outlines the flexor/extensor ratio at the angular velocities of 60°/s, 120°/s, 180°/s, and 240°/s. No significant differences were found between these mean ratios in the DL and NDL at any angular velocity. Furthermore, it was determined that all flexor/extensor ratio values were between 50% and 80% that are considered normal in the knee joint literature.

Discussion

Over the years, several studies have analyzed the knee joint musculature in athletes of various sports to elucidate balance of muscular

Table 1. Mean and standard deviation values for PT of the knee extensor and flexor musculature of the dominant and non-dominant limbs.

Angular velocities	PT knee extensors (N/m)			PT knee flexors (N/m)		
	DL	NDL	"p"	DL	NDL	"p"
60°/s	143.59 ± (39.72)	144.69 ± (33.92)	0.75	75.35 ± (20.27)	72.36 ± (18.52)	0.23
120°/s	116.44 ± (27.35)	116.28 ± (24.96)	0.94	65.83 ± (15.64)	60.23 ± (16.07)	0.11
180°/s	97.54 ± (19.33)	96.92 ± (21.42)	0.72	55.07 ± (10.42)	52.98 ± (11.70)	0.26
240°/s	79.78 ± (14.10)	81.72 ± (17.28)	0.46	50.28 ± (8.70)	47.91 ± (10.47)	0.14

DL: dominant limb; NDL: non-dominant limb; PT: peak torque.

Table 2. Mean and standard deviation values for the knee flexor/extensor ratio of the dominant and non-dominant limbs.

Angular velocities	Flexor/extensor ratio (%)		
	DL	NDL	"p"
60°/s	52.47 ± (7.44)	50.23 ± (7.45)	0.25
120°/s	56.78 ± (6.70)	52.38 ± (11.85)	0.12
180°/s	57.23 ± (9.28)	55.63 ± (11.64)	0.46
240°/s	64.05 ± (11.95)	60.45 ± (17.35)	0.12

DL: dominant limb; NDL: non-dominant limb.

characteristics between the limbs and knee joint. The musculature balance between the limbs as well as the extensors and flexors are important for decreasing the rate of musculoskeletal injuries[29-30], especially in female athletes[31]. Nonetheless, studies on adolescent handball players are uncommon in spite of young athletes and handball amateur players presenting higher rates of musculoskeletal injuries caused by the precocious practice of the sport[32]. Therefore, the purpose of this study was to analyze the isokinetic performance of the knee extensor and flexor muscles of female adolescent handball players. For limbs' comparison, the assessment of muscle strength (through mean PT values) and the agonist/antagonist balance (flexors/extensors ratio) are important parameters to be considered by any sports team[33-34]. Significant or greater than 10% differences between limbs are indicative of muscle imbalance and asymmetry of the knee extensor and flexor muscles and have been observed in young non-athlete women[35]. However, PT of extensors and flexors, and flexor/extensor ratio analysis between the DL and NDL, in this study, indicated no imbalance and asymmetry at both angular velocities.

These results are in accordance with other isokinetic studies of handball athletes[22,23,25-27,36]. Specifically in comparison with adolescent female athletes, there are no similar studies in order to have any comparison. Nonetheless, the literature presents some studies in which young female adults with a mean age of 20[23,26,36] and 26 years were assessed[26]. Lund–Hanssen *et al*.[36] and Xaverova *et al*.[26] assessed high-level athletes at angular velocities of 60°/s and 240°/s, whilst Kazazović *et al*.[23] assessed amateur athletes at angular velocities of 60°/s and 180°/s. The findings of these studies are similar to this present study as they did not demonstrate any significant differences between the limbs when analyzing mean PT and flexors/extensors ratio of the knee musculature. Male elite professional[22,25,27] and amateur[23] handball players also did not demonstrate any significant differences between the limbs in the assessment of these muscle groups at angular velocities of 60°/s and 180°/s.

Although, knee's muscle comparison between the limbs is important and it is the most mentioned method to identify muscular imbalances[37-38], the characteristics of the handball practice needs to be considered during the analysis of these results. Unlike handball, sports that require unilateral action of the lower limbs may develop asymmetries and muscular adaptations in the lower limbs[39-40]. Sports such as soccer[28,41], basketball[42-44] and volleyball[25,45-46] demonstrate significantly higher PT values and flexors/extensors ratio in the DL during assessment of the knee extensor and flexor muscles. The dominance of one limb in relation to the other is a very controversial matter and can be associated with the characteristics of each sport. Recently, the literature review by McGrath *et al*.[47] confirmed that the differences between the limbs should be primarily attributed to specific neuromuscular demands from each sport.

Another noteworthy finding of this study is the mean PT values of the adolescent athletes, which are inferior to other results of young female handball athletes[23,26,36]. This result had already been expected and we believe it is associated to the short training experience and to the age of the athletes evaluated in this study. The players evaluated in this study presented shorter mean training experience time (5.38 years) when compared to the others studies with young female athletes that reported a mean training experience of 7.9[23] and 11.5[26] years. In regards to age, De Ste Croix[48] states that anthropometric, neurological, and hormonal changes from childhood and adulthood are directly related to muscle strength alterations and, consequently, to the results of an isokinetic assessment.

Regarding the ratio flexor/extensor ratio analysis, the results of this study ranged between 50% and 64% for both limbs These values are within normal range of 50-80% for the knee joint according to literature and are mainly dependent on the angular velocity[49-50]. In contrast, Kim and Hong[51] state that there is a tendency indicating that values lower than 60% are associated with noncontact lower limbs injuries. The higher values of the flexors/extensors ratio at higher velocities which were found in our study are in agreement with previous results from female handball athletes[36,52], and they have already been shown in previous studies[50,53-55]. The analyzed flexors/extensors ratio in this study refers to the conventional ratio which is calculated from the concentric PT value of the flexors divided by the concentric PT value of the extensors[56]. This parameter basically indicates whether there is balance between the anterior and posterior thigh muscles; it has been extensively studied and it is used to describe the possible destabilization of the knee joint[57].

This study found no differences in the knee extensor and flexor PT values or flexor/extensor ratios between DL and the NDL. Furthermore,

flexor/extensor ratios were between normal values in adolescent female handball athletes. We believe that these results are due to the muscular demands imposed on these muscle groups during the handball practice, which unlike in other sports, occurs symmetrically between the limbs and flexor and extensor muscles of the knee. Knee's bilateral (dominant and non-dominant limb comparison) and ipsilateral (flexors and extensors comparison) balance is a good indicator of lower risk of musculoskeletal injuries. Thus, it can be suggested that playing handball presents lower risk of knee injuries when compared to sports that lead to some type of muscular asymmetries. Although other studies have already shown results of isokinetic assessments of handball athletes, this study is the first to show results of adolescent female athletes. Further research may use different angular velocities, and isokinetic eccentric and isometric contractions for a more thorough knowledge of muscular balance; these will expand the knowledge related to isokinetic muscular function evaluations in adolescent female handball players.

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Blood flow restriction training promotes hypotensive effect in hypertensive middle-age men

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Summary

Objectives: The purposes of this study were a) to analyze the hemodynamic responses of two methods of resistance training (vascular occlusion vs. traditional) and, b) to demonstrate the effectiveness of vascular occlusion training method on the regulation of blood pressure in hypertensive subjects.
Methods: Ten men of middle age (44.9±5.1 years, 83.7±12. kg, 174.1±8.1cm) performed two different protocols of resistance exercises (3 sets until concentric failure; leg press exercise; 60 sec pause between sets): a) with blood flow restriction (30% of 1RM intensity) and b) high intensity exercise (70% of 1RM intensity). Middle thigh muscle circumference was estimated and hemodynamic variables (heart rate, systolic and diastolic blood pressure) were measured before, immediately after and every 10 min (until 60 min) post exercise. The rate of perceived exertion was also utilized after exercise protocol. All subjects were encouraged not to perform the Valsalva maneuver.
Results: Both protocols showed a significant reduction of systolic, diastolic and mean arterial blood pressure and heart rate post 10 until 60 min compared to values immediately post exercise (p <0.05). The blood flow restriction group showed a significant reduction (p <0.05) of diastolic blood pressure 20 min post-exertion time compared to rest values. In addition, the magnitude of the effect size about diastolic blood pressure revealed a large magnitude of effect at the 20' and 30' post-effort in the blood flow restriction group.
Conclusion: Blood flow restriction protocol promoted a hypotensive effect during 60 min after it is realization.

Key words:
Blood flow restriction.
Resistance training.
Post-exercise hypotension.

Efecto hipotensor producido por entrenamiento de restricción vascular sanguíneo en hipertensos de mediana edad

Resumen

Objetivos: Los objetivos de este estudio fueron: a) analizar las respuestas hemodinámicas de dos métodos de entrenamiento de resistencia (oclusión vascular versus tradicional) y b) demostrar la efectividad del método de entrenamiento de oclusión vascular en la regulación de la presión arterial en sujetos hipertensos.
Métodos: Diez hombres de mediana edad (44,9±5,1 años, 83,7±12 kg, 174,1±8,1 cm) realizaron dos protocolos diferentes de ejercicios de fuerza (3 series hasta el fallo concéntrico, ejercicio de ejercicios de pierna, pausa de 60 segundos entre series): a) Con restricción del flujo sanguíneo (30% de intensidad de 1RM) y b) ejercicio de alta intensidad (70% de intensidad de 1RM). Se estimó la circunferencia muscular media del muslo y se midieron las variables hemodinámicas (frecuencia cardíaca, presión arterial sistólica y diastólica) antes, inmediatamente después y cada 10 min (hasta 60 minutos) después del ejercicio. La escala de esfuerzo percibido también se utilizó después del protocolo de ejercicio. Se animó a todos los sujetos a no realizar la maniobra de Valsalva.
Resultados: Ambos protocolos mostraron una reducción significativa de la presión arterial sistólica, diastólica y media ya frecuencia cardíaca post 10 hasta 60 min en comparación con los valores inmediatamente después del ejercicio (p <0,05). El grupo de restricción del flujo sanguíneo mostró una reducción significativa (p <0,05) de la presión arterial diastólica 20 minutos después del esfuerzo en comparación con los valores de reposo. Además, la magnitud del tamaño del efecto sobre la presión arterial diastólica reveló una gran magnitud de efecto a los 20' y 30' post-esfuerzo en el grupo de restricción de flujo sanguíneo.
Conclusión: El protocolo de restricción del flujo sanguíneo promovió un efecto hipotensor durante 60 minutos después de su realización.

Palabras clave:
Restricción vascular sanguínea.
Entrenamiento de resistencia.
Regulación de la presión arterial.

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Introduction

Cardiovascular disease is associated with primary risk factors that can be controlled, treated or modified, such as high blood pressure (BP). Thus, hypertension is a disease state characterized by increased blood pressure (BP) associated with hemodynamic abnormalities, including elevated systemic vascular resistance index and altered cardiac index[1,2]. The number of individuals with uncontrolled hypertension stage 1 (defined as SBP ≥140 mmHg or DBP ≥90 mmHg) increased from 605 to 978 million because of population growth and aging, consequently, increase risk factor for mortality and morbidity[3]. But a small reduction of 10 mmHg in systolic blood (SBP) and/or 5 mmHg diastolic blood (DBP) pressures can lead to 22% reductions in coronary heart disease events and a 41% reduction in stroke[4]. Physical inactivity is also known as a primary risk factor for cardiovascular disease, and people who are less active and less fit have a 30–50% greater risk for having high BP[5].

Conversely, exercise training decrease risk factor for cardiovascular disease because improve the muscle blood flow to exercising muscle and cause a more normal cardiovascular response to exercise in hypertensive subjects[6]. In this sense, not only aerobic training but also resistance exercises (RE) have been suggested in sports medicine guidelines. A meta-analytical data suggest that resistance exercise (RE) can decrease mean SBP between 10 and 13 mmHg, and 6 and 8 mmHg DBP[7]. Consequently, RE has been prescribed for the control of resting BP in hypertensive and normotensive individuals[8-10]. However, a well understanding methodological about multiple variables to prescription of RE (exercise order, rest periods between sets, specific exercises and session format, weekly frequency, movement velocity, training duration and volume, number of repetitions, sets, type of muscle action and intensity of effort) collaborate to the better control of hemodynamic parameters during and post-exercise[8,10].

Hyperemia is the transient increase in organ blood flow that occurs following a brief period of ischemia (e.g., blood flow restriction), thus, contribute with a vasodilatation by increase in blood flow to a tissue due to the presence of metabolites (adenosine, prostaglandins, and oxide nitric) and myogenic effects[11,12]. But when associated blood flow restriction (BFR) to low-intensity resistance exercise (20%-50% of 1 repetition maximum – RM) promotes an increase in heart rate to maintain cardiac output, because of the decrease in stroke volume, which results from restricted blood flow, and consequently, reduces venous blood return[13,14]. On the other hand, performing RE with the addition of BFR stimulates compensatory adaptations with vascular adaptation to facilitate greater venous return[15]. Besides promote greater shear stress against blood vessel walls on restoration of blood flow that occurs with release of occlusive pressure, which may stimulate greater nitric oxide production to promote vasodilation, and a hypotensive response post-exercise[8,16].

Few studies have evaluated the association between the post-exercise hypotensive response and low-intensity RE combined with BFR in hypertensive subjects[16,17]. But the identification of specific BP responses that might be associated with manipulation of training variables is important to ensure the optimal, and appropriate, prescription of RE for individuals concerned with BP control, such as those with chronic hypertension. Thus, bearing in mind the importance of examining the post-exercise hypotensive response to promote greater efficacy and safety during low-intensity RE with BFR, the purpose of this study was to compare an HIE session vs. low-intensity RE with BFR on the post-exercise hypotensive response in hypertensive middle age subjects.

Material and method

Participants

Ten stage 1hypertensive subjects (age 44.9±5.1 years, body mass 83.7±12.1kg, height 174.1±8.1cm, BMI 27.7±2.3 kg/m^2) with at least one year of recreational RE experience were asked to participate in the current study. All subjects completed the Physical Activity Readiness Questionnaire (PAR-Q). The experimental protocol was in accordance to the declaration of Helsinki and was approved by the local board (CMM/UNISUAM n°63881716.0.0000.5235). All participants were informed about the experimental procedures and gave written informed consent prior to participation[18]. No clinical problems occurred during the study.

The following additional exclusion criteria were adopted: a) use of drugs that could affect cardiorespiratory responses; b) bone-, joint- or muscle-diagnosed problems that could limit the execution of leg press exercise; d) metabolic disease; e) use of exogenous of medication with potential effects on physical performance.

Measures

Volunteers attended the laboratory a total of four times with 48 h between visits. During the first visit, anthropometric and hemodynamic data was collected as well as a 1-RM assessment for the leg press exercise. During the second visit, the 1-RM assessment was repeated; and the RE sessions were performed during the third and fourth visits with or without blood flow restriction. All testing was performed between 1:00 PM and 3:00 PM. Subjects received a light lunch two hours before each lab visit. Coffee, tea, alcohol and tobacco intake were prohibited for 48 hours, and subjects avoided formal and strenuous exercise for 48 hours before each visit.

Body weight was measured using a calibrated physician's beam scale (model 31, Filizola, São Paulo, Brazil), with the men dressed in shorts. Height was determined without shoes using a stadiometer (model 31, Filizola, São Paulo, Brazil) after a voluntary deep inspiration. Body fat percentage (%) was estimated using the seven-site skinfold procedures[19], and performed twice, in circuit. The mean technical error of measurement for skinfold value was 0.31. All biometric measurements were carried out in a climatized room (22±1°C). No clinical problems occurred during the study.

The middle thigh muscle circumference (MC) was estimated by circumference of the bone and muscle portions of the thigh muscle. The thigh skin-fold (TSF) was measured to represent the thickness of the subcutaneous fat that surrounds the muscle. The following formula was used to estimate the muscle-bone cross sectional area[8]:

$$\text{Muscle-Bone CSA} = MC\text{-}(\pi \times TSF/10)$$

Before beginning of each RE session, subjects rested quietly in a supine position for 10 minutes prior to measurement of resting BP. After each RE session, BP was measured immediately post-exercise and in 10-minute intervals for 60 minutes, resulting in a total of seven

readings after each RE session. Before and after each session, subjects were fitted with ambulatory BP monitoring equipment in arm (Contec medical, PM50 Monitor, Beijing, China), and this equipment was used for all pre and post-exercise BP measurements. The ambulatory BP equipment was auto calibrated before each use to ensure accuracy. Spurious readings, due to factors such as movement artifact, were automatically edited by the software. During BP rest and post-exercise monitoring, subjects remained in a supine position in a temperature-controlled quiet room (22ºC).

1RM - One-Repetition Maximum Test

Leg press exercise was selected for use in this study due to its common use in RE programs. The 1-RM tests were performed following the anthropometric measurements on the first day. After 48 h, the 1-RM test was repeated to determine test–retest reliability. The heaviest load achieved on either test day was considered the 1-RM. The 1-RM loads were determined in fewer than five attempts with a rest interval of five minutes between attempts[8]. No pause was allowed between the concentric and eccentric phases of a repetition or between repetitions. For a repetition to be successful, a complete range of motion for the exercise had to be completed. The leg press exercise range of motion for a successful repetition was defined as follows: Knees and Hip beginning in full extension followed by half flexion, while maintaining perfect postural alignment with no torso sway.

The 1-RM test has been described previously and for reliability, the following strategies were adopted: a) standardized instructions about the testing procedures were given to subjects prior to test; b) subjects received standardized instructions concerning exercise technique; c) verbal encouragement was provided during tests; d) the mass of all weights and bars was determined using a precision scale.

Resistance exercise sessions and blood flow restriction

The subjects performed a bilateral leg press exercise in a seated position. The two strength training sessions were performed on non-consecutive days and in random order, which included the following: a) three sets of leg press exercise at 70% of 1-RM (HIE protocol); and b) three sets of leg press exercise at 30% of 1-RM with BFR. Both RE protocols utilized 60 sec rest between sets.

In BFR protocol, the proximal portion of both legs was compressed by a specially designed elastic belt (width 100 mm, length 800 mm). The belt contained a small pneumatic bag along its inner surface. To partially occlude muscle blood flow, the cuff was inflated to a pressure of 20 mmHg upper the acute SBP determined after 15 min of semi-recumbent resting. The mean restrictive pressure throughout the period of training was 159.2±12.9 mmHg. The BFR was maintained throughout the session of exercise which lasted 255.2±21.3 sec for BFR protocol and 233.5±20.2 sec for the HIE protocol. The partial occlusion of muscle blood flow was restored immediately following the last RE session. The BFR protocol resulted in a total of 46.2±9.8 repetitions and the HIE protocol, 20.5±5.3 repetitions.

During each RE session, subjects were verbally encouraged to perform all sets to concentric failure, using the consistent definition of a complete range of motion used for the 1-RM test. No attempt was made to control repetition velocity. During all RE sessions, subjects were asked not to perform a Valsalva Maneuver. After both RE session was utilized OMNI scale to quantify work. All of the exercise sessions were preceded by a 10 minutes warm-up on an upper body ergometer (Technogym, New Jersey, USA) with an intensity of 20 watts.

Statistical analysis

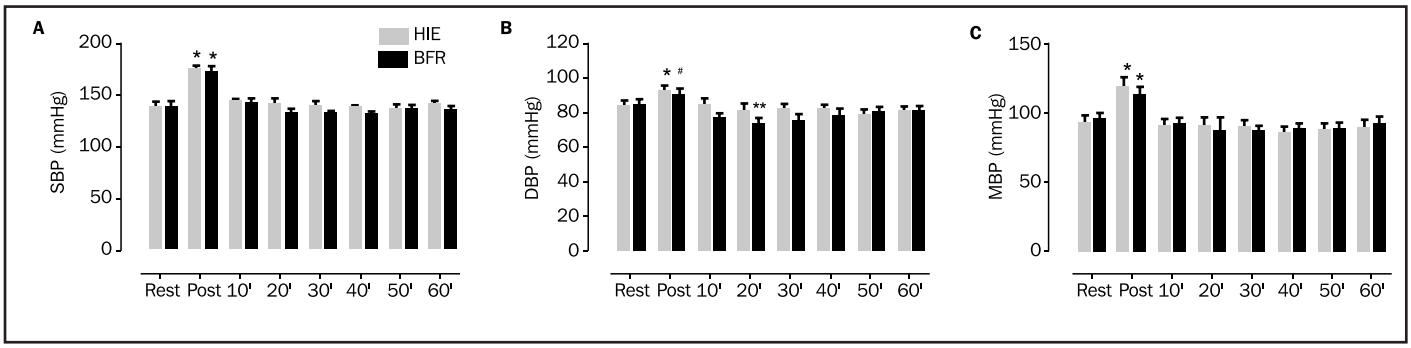
All data are presented as mean ± SD. The statistical analysis was initially performed using the Shapiro–Wilk normality test and the homocedasticity test (Bartlett criterion). To test the reproducibility of the 1-RM load between the test and retest, we used the intraclass correlation coefficient (ICC). To compare potential differences in post-exercise SBP, diastolic blood pressure (DBP), mean blood pressure (MBP), and rating of perceived exertion (OMNI scale) between BFR and HIE protocols, a repeated measures two-way analysis of variance, with Bonferroni post-hoc tests was used. Comparisons within-groups for BP were performed with ANOVA one-way repeated-measures followed by Tukeys post hoc tests. The level of significance was set at $p<0.05$ for all statistical comparisons. The effect size (ES) was calculated for the SBP and DBP responses for each RE session to determine the meaningfulness of the difference[20] and classified as: trivial (<0.2), small (>0.2–0.6), moderate (>0.6–1.2), large (>1.2–2.0) and very large (>2.0) based on recommendations[21]. The significance level was set at 0.05 and the software used was GraphPad® (Prism 6.0, San Diego, CA, USA).

Results

The ICC for the leg press exercise was 0.95 ($p< 0.001$). Besides, the estimate the muscle-bone cross sectional area no showed statically difference between limbs (right limb = 54±5.1 cm; left limb = 54.3±4.8 cm; $p = 0.17$). Figures 1–3 summarize the acute hemodynamic responses for each protocol (BFR *vs*. HIE). The SBP values were not significantly different between protocols at baseline and post effort at each time point (Figure 1). The SBP and MBP were not significantly different between protocols (Figures 1A and 1B). But both protocols showed significant difference between immediately post-exercise vs. rest and post-exercise measurements ($p<0.05$). However, within the BFR protocol, a significant decrease ($p< 0.05$) in DBP was observed at the 20-minute post-exercise time points compared with baseline (Figure 1B). None significant difference ($p>0.05$) was observed in the rating of perceived exertion (OMNI scale) between BFR and HIE protocols in three sets RE sessions (Figure 2).

Table 1 shows the effect size for SBP, DBP, and MBP each training protocol. The ES statistics presented moderate to large values for SBP at 20, 30, and 40 minutes after the BFR protocol. On the other hand, DBP revealed ES statistics moderate to large values at 10, 20, 30, and 40 minutes after the BFR protocol, while, HIE protocol moderate values only with 50 minutes. MBP showed ES statistics only 30 and 40 minutes after the BFR protocol. Additionally, the ES statistics were generally greater for the BFR protocol at each time point post-exercise.

Figure 1. Systolic blood pressure (SBP), Diastolic blood pressure (DBP), and Mean blood pressure (MBP) at rest, immediately post-exercise, and at 10-minute intervals during 60 minutes after resistance exercise (RE) for the blood flow restricted and High Intensity exercise (HIE) protocols.



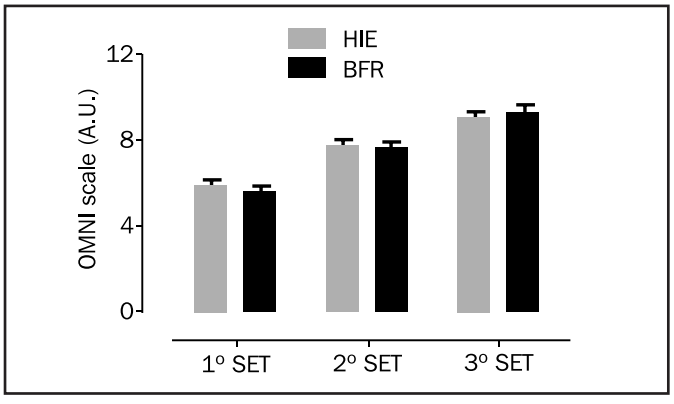
Data are presented as mean ± SD.* and # $p<0.05$ *vs.* rest; ** $p< 0.05$ *vs.* rest

Table 1. Effect Size calculation and classification of blood pressure values compared to rest for high intensity and blood flow restriction protocols during 60 min after exercises.

	10 min	20 min	30 min	40 min	50 min	60 min
Systolic Blood Pressure						
BFR	-0.17	0.57	0.71	0.81	0.26	0.34
	Trivial	Moderate	Moderate	Large	Small	Small
HIE	-0.40	-0.04	0.06	0.27	0.29	0.06
	Small	Trivial	Trivial	Small	Small	Trivial
Diastolic Blood Pressure						
BFR	0.60	0.95	0.82	0.51	0.35	0.28
	Moderate	Large	Large	Moderate	Small	Small
HIE	-0.06	0.32	0.33	0.26	0.54	0.33
	Trivial	Small	Small	Small	Moderate	Small
Mean Blood Pressure						
BFR	0.22	0.55	0.62	0.56	0.44	0.26
	Small	Small	Moderate	Moderate	Small	Small
HIE	0.16	0.09	0.24	0.55	0.41	0.26
	Trivial	Trivial	Small	Moderate	Small	Small

BFR: blood flow restriction protocol; HIE: high-intensity resistance exercise protocol.

Figure 2. Rating of perceived exertion (OMNI scale) between BFR and HIE protocols.



Discussion

The aim of this study was to compare post-exercise hypotensive responses after an HIE session vs. a low-intensity BFR session in stage 1hypertensive subjects and the main findings were that BFR protocol significantly decreases diastolic blood pressure post-exercise compared to high intense exercise. as follows: a) no significant differences between protocols in the SBP, DBP, and MBP responses post-exercise at any time point; b) BFR protocol, significant decreases in DBP occurred at 20-minute post-exercise than compared to rest; c) BFR protocol promoted a moderate to large ES at most time points in SBP, DBP, and MBP post-exercise. These results may suggest that the duration of the hypotensive response might not only be dependent on differences in the rest interval between sets or load intensity (30% in the BFR vs.

70% in the HIE) but rather on the ischemic effects induced during the BFR protocol. This way, after exercise session the ischemic reperfusion mechanism induced by cuff deflation stimulates shear stress, followed by greater vasodilatation and/or enhanced blood flow that can be contribute to hypotensive response[8].

During both RE protocols (BFR *vs*. HIE), significant increases were observed in SBP, DBP, and MBP. The amount of muscle mass recruited during exercise is positively related to the increase in BP because of compression of vascular beds during concentric actions that occludes the circulation and consequently raises vascular resistance[8,22]. Additionally, the application of external compression as in the BFR protocol reduced venous return with concomitant stimulation of group III (mechanosensitive) and group IV (metabosensitive) muscle afferents (according to the temperature, chemical and the mechanical environment) being favorable to a reflex increase in sympathetic nerve activity that promote a greater heart rate and arterial blood pressure to maintain cardiac output[23,24]. Besides, the increased local muscle metabolites (H^+, lactate, and ADP) and heat production seem to contribute for the increased hemodynamic responses after moderate and high intensity exercise[25]. However, current study showed that the BFR protocol promotes a lower hemodynamic response compared to the HIE and LIE performed to muscular failure[25].

Few studies have compared a low-intensity BFR session *vs*. HIE session in hypertensive subjects[17] demonstrated that BFR protocol (three sets; 10 repetitions; 20% 1RM) *vs*. HIE protocol (three sets; 10 repetitions; 65% 1RM) no showed hemodynamic (SBP and DBP) statistically significant differences between exercise protocols. On the other hand, the rating of perceived exertion was significantly higher between sets (1st *vs*. 2nd *vs*. 3rd sets) of the traditional high-intensity resistance exercise than compared to exercise with BFR[17]. Our hemodynamic results were similar to another study[17], even using different load and exercises (knee extension machine *vs*. leg press), which suggests that this response may be associated with potential capacity of BFR in enhancing systemic vascular response and the heart after load[8,14]. Our results to resting perceived exertion was similar no significant differences between protocols. Possibly, hypothesis show that Large muscle groups, used in multi-joint exercises such as leg press, trigger a higher absolute number of neural recruitment and maybe a higher asynchronous recruitment, allowing a better recovery of the muscle fibers, which could reduce the fatigue[26].

Other study compared hypotensive response in hypertensive women between a low-intensity BFR session (three sets; 15 repetitions; 30%1RM) *vs*. HIE session (three sets; 15 repetitions; 80%1RM) in the knee extension exercise[16]. Results showed significant hypotensive response only to SBP in BFR session, but not in the HIE session, between 15- and 60-minutes post exercise. We did a research with normotensive subjects that performed 2 experimental protocols in randomized order: a) 3 sets at 80% of 1 repetition maximum (RM) and 120-second rest between sets (HIE protocol) and b) 3 sets at 40% of 1RM with BFR and 60-second rest between sets. Both protocols the biceps curls exercise was performed to all subjects[8]. The values for SBP, DBP, and mean blood pressure (MBP) at baseline and post-exercise were not significantly different between the HIE *vs*. the BFR protocol. However, within the BFR protocol, significant decreases in SBP occurred at 30 minutes and 40 minutes after exercise when compared with baseline and significant decreases in DBP and MBP occurred at 20 minutes, 30 minutes, and 40 minutes after exercise *vs*. baseline[8]. But the magnitude of the ES was moderate only with 20 minutes post-exercise to DBP[8]. Results of the current study showed that key finding was that the BFR protocol promoted a long-lasting hypotensive DBP response and magnitude of the ES about SBP, DBP, and MBP various from moderate to large. Possible hypothesis to hypotensive DBP response can be that the double leg-press resistance exercise transiently reduces systolic LV mechanics, but increases diastolic mechanics following exercise, suggesting that resistance exercise has a differential impact on systolic and diastolic heart muscle function[27]. Our study showed lower DBP > 10 mmHg between rest (83.3±10.9 mmHg) and 20 minutes post-exercise (73.3±10.4 mmHg). Thus, studies concluded that a decrease =or> 10 mmHg in DBP is associated with 37% lower risk of coronary heart disease events and a 56% lower risk of stroke events[2].

The measurement of BP using the oscillometric method may have been a possible limitation of this study, but care was taken to calculate the appropriate sample size and food recall 24 hours before the collections were performed to increase the internal validity of the research. Additionally, other limiting factors that might be considered in future studies include levels of endothelium-dependent vasodilator agents, local metabolites, autonomic sympathetic activity, and cardiac output, which would provide further insight into the mechanisms behind the observed responses.

Conclusions

Low intensity exercise with blood flow restriction protocols could be performed to promote a post-exercise hypotensive effect in stage 1 hypertensive men. Therefore, it is suggested that either resistance exercise protocols should be used safely and effectively in hypertensive subjects.

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Rating of perceived exertion and sustainability of repetition during resistance exercise in cigarette smoker and non-smoker men

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Summary

Introduction: Regarding lack of clear information about the effects of smoking on rating of difficulty sensation during resistance exercise and to clarify the influence of cigarette use on exercise performance, the aim of this study was to compare the rating of perceived exertion (RPE) and sustainability of repetition in different intensities of resistance exercises between cigarette smoker and non-smoker men.
Methods: Ten untrained cigarette smoker and ten untrained cigarette non-smoker men performed bench press and leg press exercises with 50, 70 and 90% of one repetition maximum (1RM) for four consecutive sets. After completing each set, the number of repetitions and the RPE were measured.
Results: There were no significant differences between smoker and non-smoker in number of repetitions during bench press and leg press exercises; however, both the experimental groups indicated decrements in number of repetitions with increases in exercise intensity and number of sets. Moreover, these decrements were greater for the cigarette smokers. The cigarette smoker men showed greater RPE during bench press exercise at set 3 and 4 with 50% of 1RM and set 4 with 70% of 1RM ($P \leq 0.05$). In leg press, there were significant differences between cigarette smoker and non-smoker at set 4 with 70% of 1RM and set 2, 3 and 4 with 90% of 1RM ($P \leq 0.05$).
Conclusion: According to the different RPE between cigarette smoker and non-smoker men, it seems that cigarette smoker men exhibit greater discomfort during same resistance exercise protocol.

Key words:
Resistance exercise. Smoking. Sustainability. Perceived exertion.

Escala de esfuerzo percibido y sostenibilidad de repetición en entrenamiento de fuerza en hombres fumadores y no fumadores

Resumen

Introducción: Con respecto a la falta de información clara sobre los efectos del tabaquismo en la escala de sensación de dificultad durante el entrenamiento de fuerza y para aclarar la influencia del tabaquismo en el ejercicio, el objetivo de este estudio fue comparar la escala de esfuerzo percibido (RPE) y la sostenibilidad de repetición de diferentes intensidades en ejercicios de fuerza entre hombres fumadores no fumadores.
Método: Diez hombres fumadores no entrenados y diez no fumadores no entrenados realizaron ejercicios de press de banca y press de piernas al 50, 70 y 90% de su repetición máxima (1RM) durante cuatro series consecutivas. Después de completar cada serie, se midieron el número de repeticiones y el RPE.
Resultados: No hubo diferencias significativas entre fumadores y no fumadores en el número de repeticiones durante los ejercicios de press de banca y press de piernas; Sin embargo, ambos grupos experimentales mostraron disminuciones en el número de repeticiones con incrementos en la intensidad del ejercicio y el número de series. Además, estas disminuciones fueron mayores para los fumadores. Los hombres fumadores mostraron mayor RPE durante el ejercicio de press de banca en las series 3 y 4 al 50% del 1RM y en la serie 4 al 70% de 1RM ($P \leq 0.05$). En la prensa de piernas, hubo diferencias significativas entre el grupo fumador y el no fumador en la serie 4 al 70% de 1RM y en las series 2, 3 y 4 al 90% de 1RM ($P \leq 0.05$).
Conclusión: En relación a los diferentes valores en RPE entre hombres fumadores y no fumadores, parece que los fumadores muestran una mayor incomodidad durante el mismo protocolo de ejercicios de fuerza.

Palabras clave:
Ejercicio de fuerza. Tabaquismo. Sostenibilidad. Esfuerzo percibido.

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Introduction

It has been well documented that rating of perceived exertion (RPE) is a good tool to monitor the intensity of exercise, stress or magnitude of discomfort during training[1]. Different sensation of fatigue for the various parts of the body are caused by anatomical status and body movements[2,3], resulting in different RPE during upper- and lower-body exercises[1,4].

There were two man pathways for perceived exertion during exercise including peripheral physiological mediators and metabolic respiratory. Metabolic-respiratory signals act with cardiovascular system and the elevation of that pathway is in relation to metabolic demands[5]. However, peripheral physiological mediators rise induced by recruitment and stimulation of muscles (e.g. legs, trunk, shoulders, or neck) during exercise[1]. The metabolic-respiratory mediators are respiratory stimulants[1,3,6,7], CO_2 release[1,7], O_2 consumption[3,4,8], heart rate[1,6], and blood pressure[6,8]. In addition, physiological procedures and the mediators related to peripheral stimulation are metabolic acidosis (pH and lactic acid), elasticity specificity of slow and fast twitch muscle fibers, muscle blood flow and muscle's energy substrates (e.g. glucose, fatty acids and glycerol)[1].

Regarding increases number of cigarette smokers in the world, it is necessary to assess the effects of cigarette smoking on human health. Smoking is in relation to several cardiovascular diseases such as hypertension, atherosclerosis and cardiac disease[9], and also affects the quality of physical activity and sport performance. It has been well documented that exercise training could promote health related variables; however, American Department of Health indicated that smokers have fewer propensities to exercise than non-smokers[10]. It is believed that smokers experienced higher RPE than non-smokers, and this situation induced restriction in sport activities[10].

Cigarette smoking has effects on metabolic-respiratory and peripheral mediators. Elevation of heart rate during and after the exercise and also at rest could be a sign of weakness in cardiovascular system[11,12]. The stimulation of sympathic nervous system induced by smoking could generally affect elevation in heart rate[12], and greater resting oxygen consumption[12]. Other negative effects of smoking are elevation of systolic and diastolic blood pressure and pulmonary ventilation[10,12]. Regarding, the effects of the smoking on peripheral mediators of perceived exertion[13] it is well known that smoking accelerated the metabolic acidosis process, increases resting blood glucose level and reduced the percentage of slow twitch muscle fibers, muscle blood flow and insulin response[13,14]. Thus, it appears that elevation of RPE is in line with metabolic-respiratory increment and peripheral mediators in smokers[13]; however, this report was not established clearly.

Although, the possible adverse effects of smoking on RPE have been shown by literature, very few studies investigated the effect of smoking on RPE and consistency of performance during physical activity. Rotstein *et al*.[12] found that cigarette smokers were able to carry out exercise (10-minutes aerobic exercise, 60% of VO_2max) and their perceived exertion were not higher than non-smokers. Gardner *et al*.[15] examined the effect of vascular occlusion in leg muscles of cigarette smokers and non-smokers within walking. They observed that peripheral blood flow restriction led to superior performance of non-smokers compared to smokers. Moreover, they also completed more distances; however, there was no difference between male and female smokers in RPE[16].

Although previous studies have only investigated the effects of smoking on RPE during aerobic exercises, less attention has been provided on resistance exercises and there is no previous information regarding the effects of smoking on the ability to sustain of resistance exercises and RPE. Regarding the prevalence of resistance exercise among adults, the influence of cigarette use on exercise performance during resistance exercise is unclear. Therefore, the present research aimed to compare the RPE and ability to sustain of repetitions at different intensities of upper- and lower-body resistance exercises between cigarette smoker and non-smoker men. We hypothesized that the ability to sustain of repetitions during resistance exercise are greater in non-smoker men with lower RPE in comparison to smoker men.

Material and method

Participants

Twenty healthy men volunteered to participate in this study. The subjects had not any experience in resistance exercise and training. Before inclusion to study, the subjects were screened by physician and were free from cardiorespiratory and blood diseases or allergies and had not any physical problem or discomfort for performing resistance exercises. Inclusion criteria for smokers were smoking at least 15 cigarettes a day for at least one year. The subjects did not use drugs and supplements that could influence the results (vitamin supplements) and had not any oral infection and acute disease in the past 6 months (which requires the use of antibiotics). All subjects were carefully informed about the experimental procedures and about the possible risks and benefits associated with participation in the study. The study was conducted in accordance with the Declaration of Helsinki II and the study was approved by an institutional ethics committee from the University (Table 1).

Study design

Subjects in both groups recruited to the laboratory on seven occasions with 48 h apart at 4-7 PM, respectively. On the first visit,

Table 1. Baseline values of non-smokers and smokers (M ± SD).

Variables	Non-Smokers (n = 10)	Smokers (n = 10)
Age, y	24.9 ± 2.8	22 ± 2.3
Height, cm	174.1 ± 5.2	175.3 ± 5.6
Weight, kg	72.9 ± 6.8	75.5 ± 8.2
Body fat, %	15.4 ± 3.5	17.7 ± 5.7
1RM (bench press), kg	49 ± 11.1	47 ± 12.9
1RM (leg press), kg	127.5 ± 20	110 ± 29.9
Resting heart rate, bpm	76.3 ± 4.4	79.2 ± 8.1
Systolic blood pressure, mm Hg	126 ± 10.6	128.7 ± 17.3
Diastolic blood pressure, mm Hg	83.8 ± 7.1	85.9 ± 10.1

subjects were familiarized with exercise and testing procedures. During this session subject characteristics such as; age, height (Seca 222, Terre Haute, IN), weight (Tanita, BC-418MA, Tokyo, Japan), percent body fat[17] and cardiovascular variables such as systolic and diastolic blood pressure (sphygmomanometer [Missouri®] and stethoscope [Rappaport® GF Health Products, Northeast Parkway Atlanta]) and resting heart rate (Polar S610i heart rate Monitor, FIN, 90440, FINLAND) were measured. The subjects were instructed to maintain their usual diet, have adequate rest the night before the test, drink enough water, and avoid intense physical activity at least 24 hours prior to the test. Smokers were asked not to smoke just before the test. On other days, the subjects participated 4 set to failure for bench press, and leg press with volitional lifting velocity. The subjects performed the selected percentages of 1RM for 2 exercises (i.e., leg and bench presses) on different days. Each subject attempted 2 different exercises at 50, 70, and 90% of 1RM, which was balanced, matched, and randomized. After completing each set, the RPE was measured for each subject. To standardize the exercise procedures, a one-week orientation took place consisting of three sessions in which the methods and techniques of the exercise programs were demonstrated.

One repetition maximum testing

A bilateral leg press test was selected to provide data on maximal strength through the full range of motion of the muscles involved. Maximal strength of the lower extremity muscles was assessed using concentric 1RM leg press action. Bilateral leg press tests were completed using standard leg press equipment (Nebula Fitness, Inc., Versailles, OH), with the subjects assuming a sitting position and the weight sliding obliquely at 45°. On command, the subjects performed a concentric leg extension (as fast as possible) starting from the flexed position to reach the full extension against the resistance determined by the weight. Warm-up consisted of a set of 10 repetitions at loads of 40-60% of the perceived maximum. For the bench press, each subject lowered the bar until contact with the chest was achieved and subsequently lifted the bar back to the fully extended elbow position. Any trials failing to meet the standardized technique criteria were discarded. A warm-up consisting of 5-10 repetitions with approximately 40-60% of perceived maximum was performed. The rest period between the actions was always 2 minutes. Subjects were allowed to perform maximum 8 repetitions during bench press and leg press, and were used equation of Brzycki[18] for the determine of 1RM;1RM = Weight / 1.0278 – (repetitions × 0.0278). The reliability coefficient (ICC) for 1RM was 0.93.

Exercise program

The subjects took part in 6 testing sessions (except the familiarization session). The sequence of the exercises were performed during 6 days of testing, during which the subjects performed 4 set to failure for the bench press, and leg press with volitional lifting velocity. The subjects performed the selected percentages of 1RM for 2 different exercises on different days. Each subject attempted 2 exercises at 50, 70, and 90% of 1RM, which was balanced, matched, and randomized. For example, in one testing sessions the subjects performed 50% of 1RM for the bench press and, 70% of 1RM for the leg press. Before the testing, the subjects performed a 10-min general warm-up consisting of ballistic movements and flexibility exercises to increase blood circulation and temperature of the involved muscle groups. A specific warm-up consisted of 1 set of 5 repetitions at 50-60% of 1RM. The rest between the exercises was 20-30 minutes and the subjects could rest at least 48 hours between each testing session. Also, the subjects had 2-min rest among sets to ensure recovery. Repetitions performed with poor technique or which were not performed properly was not taken into account. The rating of the perceived exertion was obtained by the Borg 15-category scale after each set of exercises[19].

Statistical analysis

All of the values presented as mean ± SD. A two-way analysis of variance was used to analyze the data. In the event of a significant F ratio, the Tukey post hoc test was used for pair-wise comparisons. The level was set at $P \leq 0.05$ for statistical significance. All statistical analyses were performed through the use of a statistical software package (SPSS®, Version 16.0, SPSS, Chicago, IL).

Results

There were no significant differences ($P \leq 0.05$) between cigarette smokers and non-smokers in the number of repetitions of the bench press and leg press. When the number of sets increased, both groups showed decrements in the number of repetitions at 50, 70 and 90% of 1RM bench press and leg press ($P \leq 0.05$). In addition, there was significant difference between intensities of resistance exercises in smoker and non-smoker men ($P > 0.05$). Likewise, no significant differences were observed in the number of repetitions in both exercises for the experimental groups (Table 2).

Progressive increases in RPE according to increases in exercise intensity and the number of set were observed for both groups. The RPE on the 3rd ($P=0.037$) and 4th ($P=0.011$) sets of the bench press and leg press at 50% of 1RM was higher for the cigarette smokers compared to non-smokers. In addition, significant difference was found on the 4th set of bench press at 70% of 1RM ($P=0.05$). Significant differences were found between cigarette smokers and non-smokers in leg press at 4th set of 70% of 1RM, and 2nd, 3rd and 4th sets at 90% of 1RM (Figure 1).

Discussion

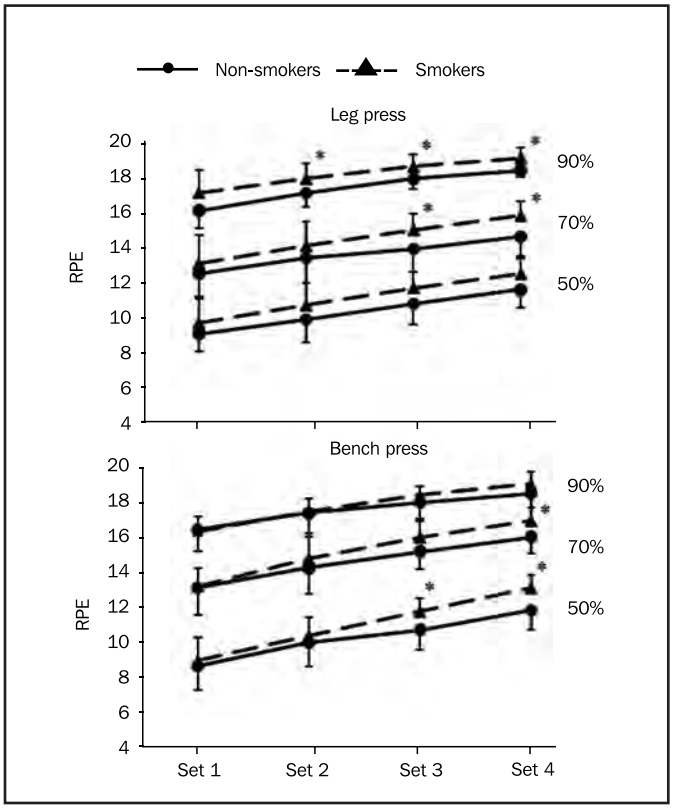
The aim of this study was to compare the ability to sustain of repetitions and rate of perceived exertion during bench press and leg press exercises at 50, 70 and 90% of the 1RM in cigarette smoker and non-smoker men. The results showed decrements in number of repetitions after increases in exercise intensity. Although, smoker and non-smoker groups showed a drop in the number of repetitions, the smokers performed fewer repetitions, no significant difference, when compared with non-smoker group. Regarding perceived exertion, greater RPE scores were observed with elevation of exercise intensity. On the other hand, progressive increases in RPE was found with increases in intensity (90>70>50) and number of sets (4>3>2>1). The RPE scores in set 3 and 4 of bench press at 50% of 1RM were higher for the smokers compared

Table 2. The number of repetitions performed by two groups (M ± SD).

Variables	Non-Smokers (n = 10)	Smokers (n = 10)
Bench press (50% of 1RM)		
1st set	18 ± 1.8	16.3 ± 1.8
2nd set	14.2 ± 1.7[a]	13.1 ± 1.7[a]
3rd set	11.3 ± 1.7[b]	10.2 ± 1.6[b]
4th set	8.6 ± 1.8[c]	7.8 ± 1.1[c]
Bench press (70% of 1RM)*		
1st set	10.6 ± 1.2	10.6 ± 1.5
2nd set	7.6 ± 0.9[a]	7.6 ± 1.7[a]
3rd set	5 ± 1[b]	4.8 ± 1.6[b]
4th set	2.6 ± 0.9[c]	2.3 ± 1[c]
Bench press (90% of 1RM)*†		
1st set	3.6 ± 0.9	3.3 ± 0.8
2nd set	2.1 ± 0.8[a]	1.9 ± 0.5[a]
3rd set	1.2 ± 0.4[b]	1.1 ± 0.4[b]
4th set	0.85 ± 0.2[c]	0.8 ± 02[c]
Leg press (50% of 1RM)		
1st set	20 ± 2.2	19.5 ± 2.8
2nd set	16.6 ± 2.1[a]	14.5 ± 2.5[a]
3rd set	13.2 ± 2.6[b]	11.1 ± 2.4[b]
4th set	9.6 ± 2.1[c]	8.2 ± 2.4[c]
Leg press (70% of 1RM)*		
1st set	11.4 ± 1.6	10.9 ± 1.8
2nd set	8 ± 1.3[a]	7.4 ± 1.5[a]
3rd set	5.3 ± 1.1[b]	4.4 ± 0.8[b]
4th set	2.9 ± 0.9[c]	2.3 ± 0.6[c]
Leg press (90% of 1RM)*†		
1st set	3.9 ± 0.9	3.7 ± 1.1
2nd set	2.3 ± 0.6[a]	2.1 ± 0.5[a]
3rd set	1.3 ± 0.4[b]	1.3 ± 0.4[b]
4th set	0.85 ± 0.2[c]	0.8 ± 0.2[c]

*Significant difference with 50% of 1RM $P \leq 0.05$. †Significant difference with 70% of 1RM $P \leq 0.05$. [a]Significant difference with set 1 $P \leq 0.05$. [b]Significant difference with set 1 and 2 $P \leq 0.05$. [c]Significant difference with set 1, 2 and 3 $P \leq 0.05$.

Figure 1. Comparison of RPE between two groups.



*Significant difference between groups at $P \leq 0.05$.

to non-smokers. In addition, significant difference was found on the 4th set of bench press at 70% of 1RM. Significant differences were found between cigarette smokers and non-smokers in leg press at 4th set of 70% of 1RM, and 2nd, 3rd and 4th sets at 90% of 1RM.

We found decreases in number of repetitions during resistance exercise when the exercise sets increased. These findings are in line with previous studies[20-27] who found decrements in repetitions following resistance exercise sets.

An important mechanism for reducing number of repetitions could be due to metabolite production following exercise. Lactate is an exercise-induced metabolic product and elevation of lactate production is depending on exercise intensity, and utilize of glycolysis and glycogenolysis pathways during resistance exercise is in relation to exercise intensity resulting in H^+ increases and muscle cells acidity[28].

The ability of muscles to produce powerful contraction will be decreased when blood H^+ increases and the level of pH decreases. In this situation the ability of muscle to continue number of repetitions during resistance exercise will be dropped[29]. The sustainability of repetitions may be attributed to the ability of maintain muscular power output. With regard to type and duration of resistance exercises, of the ATP-PCr system plays an important role. Increment in lactate and other metabolites could lead to decreases in muscular power output and limitation of several enzymes activity which made the ATP production. On the other hand, enhancement in blood metabolites is in line with reduction of muscle ability to sustain energy production resulting in number of repetition decreases[30]. Although in this study we did not measure lactate and H^+, the influence of these metabolites on muscle performance during resistance exercise and also decrements in number of repetitions were confirmed by previous documents[22,23].

Regarding cigarette use previous studies reported acceleration of metabolic acidosis[13,14] resulting in greater decrements in anaerobic performance; however, the present study showed no significant difference between smoker and non-smoker men in the number of repetitions during resistance exercise sets. It seems that short duration of cigarette use (because of young subjects) and few numbers of subjects could be a reason for these findings and more studies are necessary for this subject.

Regarding RPE scores, the present study that RPE scores for cigarette smokers in sets 3 and 4 of bench press at 50% of 1RM was greater than non-smokers. This finding occurred for set 4 of bench press at 70% of 1RM. Furthermore, significant difference was found between cigarette smokers and non-smokers for leg press in the set 4 at 70% of 1RM, and set 2, 3 and 4 at 90% of 1RM. These results are in agreement with the study of

Gardner *et al.* (1999) who found higher RPE scores for cigarette smokers compared to non-smokers[15]. Conversely, some researchers found that RPE did not significantly differ between smokers and non-smokers[12, 16]. Different findings from various studies may be due to the dissimilarities within exercise protocol, exercise intensity and subject's fitness status.

Both groups reported progressive increment in RPE scores with elevation of exercise intensity. Consistent with these findings, previous studies[20-26] found that increases in RPE with increases in exercise intensity. Legally *et al*[4] observed that during resistance exercise, active muscle(s) signals play overriding role in RPE scores[4]. Other evidence recorded muscle activity during resistance exercise by electromyography[31]. When exercise intensity increased, activation of muscle fibers increased and resulted RPE rises because of great stimulation and response of the sensors within activated muscles occurrd[4,22,26].

Cigarette use accelerated metabolic acidosis process, stimulated metabolic and peripheral mediators and sympathic nervous system resulting in RPE elevation in smokers. Additionally, elevation of RPE have been confirmed with increased muscle activation, greater muscle fiber recruitment and firing rate[32]. The positive and incremental gradient of RPE with increasing exercise intensity and the number of sets is in line with increases in sensory signals within activated muscles which can be accompanied by fatigue due to the accumulation of metabolites. Furthermore, fatigue and greater RPE scores could be due to reduction of plasma creatinine, blood pH, and increases in muscle lactate and decreases in muscle carbohydrate[1,22-32,33]; however, in this study these variables did not measure and could be guess and speculation.

Conclusion

It could be concluded that the ability to sustain repetitions during resistance exercise will be decreased when number of sets increased. This finding could be affect by cigarette smoking. In addition, amount of perceived exertion increased by enhancing exercise intensity and number of sets. It seems that metabolic and peripheral mediators affect perceptual mechanisms and muscle fiber ability to sustain number of repetition and also perceived exertion. Since the information about the effects of cigarette use on the quality and quantity of training are scarce, more research is necessary to clarify whether cigarette use affects sport performance, especially resistance trainings.

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Recommendations to the Medical Services in Spanish federations by sport, for the inclusion of athletes with disabilities (second part)

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Summary

The inclusion of people with disabilities is a priority axis in social development policies, both in Spain and in the rest of the world. Also, in practice of physical and sports activities, where they are already an example that can be extrapolate to other areas of the society. Currently the International Sports Federations (one-sport) are developing their inclusive processes to accommodate athletes with disabilities of their sport; this process has already become a widespread and irreversible worldwide sport movement. This situation is being conducted by the "Consejo Superior de Deportes" (Spanish Sport Council) and the Spanish Paralympic Committee, a process that must culminate with the incorporation, to these national federations by sport, of all people disabled or not, who want to practice their modalities, in a single sport organizational model.

In its first part, "Recommendations to the Medical Services in Spanish federations by sport, for the inclusion of athletes with disabilities", it already pointed out that the structure and organization of Federative Medical Services (SMF) must not be alien to the inclusive process and adaptation in all the federative structures. Therefore, now, the rest of the necessary and significant actions and adaptations are complete, as in physiotherapy, orthopedics and technical aids, health care, psychology and structural adaptations of the SMF also. This review, as a whole, has as main objective to guarantee, through its recommendations, quality services, which can be offer in the same measure to athlete with or without disability in equal treatment. Providing recommendations and more knowledge to the process of inclusion in the federated Spanish sport, so that it reaches success, and can guarantee a good service to all its athletes, following the most current criteria of good inclusive practices.

Key words:
Inclusion. Sport integration. Adapted sport. Disabled athlete. Adapted sport federations (multi-sport). Federations by sport (conventional). Medical sport services. Adapted sport psychology.

Recomendaciones a los Servicios Médicos de federaciones españolas unideportivas, para la inclusión de deportistas con discapacidad (segunda parte)

Resumen

La inclusión de las personas con discapacidad es un eje prioritario en las políticas de desarrollo social, tanto en España como en el resto del mundo, también en la práctica de las actividades físicas y deportivas, donde ya son un ejemplo extrapolable a otros ámbitos de la sociedad. Actualmente las Federaciones Deportivas Internacionales (unideportivas) están desarrollando sus procesos inclusivos para acoger a los deportistas con discapacidad de sus modalidades deportivas, este proceso ya se ha convertido en un hecho generalizado e irreversible a nivel deportivo mundial. También las federaciones deportivas españolas, tanto de deporte como las plurideportivas de personas con discapacidad han iniciado, a distintos niveles, este proceso inclusivo. Esta situación está siendo conducida por el Consejo Superior de Deporte y el Comité Paralímpico Español, proceso que ha de culminar con la incorporación, a estas federaciones nacionales por deporte, de todas las personas discapacitadas o no, que quieren practicar sus modalidades, en un sólo modelo organizativo.

En su primera parte, "Recomendaciones a los Servicios Médicos de federaciones españolas unideportivas, para la inclusión de deportistas con discapacidad", ya se remarca que la estructura y organización Servicios Médicos Federativos (SMF) no debe ser ajena al proceso inclusivo y de adecuación en las estructuras federativas. Por lo cual, ahora, se completan el resto de acciones y adaptaciones necesarias y significativas, como en la fisioterapia, ortopedia y de ayudas técnicas, atención sanitaria, psicológica y también de adaptaciones estructurales de los SMF. Esta revisión, en conjunto, tiene como objetivo principal garantizar, a través de sus recomendaciones, unos servicios de calidad, que puedan ser ofrecidos en la misma medida a deportista con o sin discapacidad en igualdad de trato. Aportando recomendaciones y más conocimiento al proceso de inclusión en el deporte federado español, para que éste alcance el éxito, y pueda garantizar un buen servicio a todos sus deportistas, siguiendo los criterios más actuales de buenas prácticas inclusivas.

Palabras clave:
Inclusión. Integración en el deporte. Deporte adaptado. Deportista con discapacidad. Federaciones de deporte adaptado (plurideportivas). Federaciones unideportivas (convencionales). Servicios médicos federativos. Psicología del deporte adaptado.

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Introduction

The inclusion of people with disabilities is a priority focal point of social development policies in Spain, Europe and around the world[1], with competition sport being an important way of achieving social inclusion goals (Martínez-Ferrer, 2004)[2]. We feel that world adapted sport is currently experiencing a historical time in terms of favouring the inclusion of these athletes in their sporting modality; whatever the physical, mental or sensorial characteristics of the people that perform them.

In 2004 in Cairo (Egypt), the Extraordinary Assembly of the International Paralympic Committee (IPC) approved favouring the inclusion of different sports and Paralympic athletes in the International Sporting Federations (single-sport). This new strategy is being applied in Spain by the Superior Board of Sport (SBS), with the gradual and progressive inclusion of people with disabilities and their sporting modalities, towards their incorporation into national federations for sport (single-sport). As the first part of this review explains, Federated Medical Services (FMS) should not be an exception in this fascinating inclusive and adaptation process; and this second part covers the other adjustments and adaptations that we consider to be the most essential and significant, including the latest new changes and the main services provided, as well as structural changes, which are also important in ensuring a good federated service to all athletes under the current criteria of good inclusive practices (Segura J, *et al.*)[3].

Repercussions of the federative inclusive process in Spain

Diverse sporting modalities have already been pushed into the sphere of competitions, with International Federations of Sports for People with Disabilities, to Sporting Federations for Sport (single-sport), having already developed inclusive/integrated competitions for athletes with different disabilities. Even the Paralympic Games in Rio 2016 moved 10 sporting modalities to these federations[2] (displayed in Table 1).

Since 2008 and following the international model, the Spanish Paralympic Committee (SPC) has been promoting agreements with Spanish Olympic federations to join forces to ensure that Paralympic sport improves day after day in social interest and respect for diversity. Currently contacts are being made for the inclusive development of the Paralympic modalities of Cycling, Horse Riding, Canoeing, Triathlon, Tennis, Table Tennis, Archery, Olympic Shooting and Windsailing, among others.

In this second part of the review, more adjustment and general adaptation proposals will be presented, from Spanish single-sport federations, arising from the "Inclusion protocol of competition sport of people with disabilities in conventional sporting federations – single-sports, in Spain"[4].

In this second part of the review, more proposals are presented for adjustment and general adaptations of the Spanish single-sport federations, taken from the "Inclusion protocol in competition sport for people with disabilities in conventional – single-sport sporting federations in the Spanish State"[4].

Table 1. Relationship between sports and international single-sport federations in the inclusion/integration process in the world Paralympic Movement.

• **Canoeing**	*International Canoe Federation* (ICF)
• **Cycling**	*Union Cycliste Internationale* (UCI)
• **Curling**	*World Curling Federation* (WCF)
• **Horse riding**	*International Equestrian Federation* (FEI)
• **Rowing**	*International Rowing Federation* (FISA)
• **Tenis**	*International Tennis Federation* (ITF)
• **Table tennis**	*International Table Tennis Federation* (ITTF)
• **Archery**	*Fedération Internacional de Tir á l'Arc* (FITA)
• ***Triathlon***	*International Triathlon Union* (ITU)
• **Sailing**	*International Federation for Disabled Sailing* (IFDS) Dependent on the International Sailing Federation (ISAF)

Source: International Paralympic Committee webpage (consulted 2012/2016).

Other proposed adaptations of the federated medical services

This section defines the specific, healthcare-related, structural and technical adjustments and adaptations of the FMS, to provide services and to monitor all athletes, including those with some kind or degree of disability.

Physiotherapy and orthopaedic technical supports

Athletes that have some kind of disability require the services and care of physiotherapy professionals to maintain their physical and biomechanical faculties, particularly their muscles and joints[5,6]. In some cases, this is due to the excessive demand of over-loaded areas, for example, the shoulders and shoulder girdle in athletes that use wheelchairs and that may also use them in their everyday life. In other cases this can be anatomical areas, that due to limited usage or paralysis, require movement and passive manipulation to prevent unwanted effects, such as contractures and ankylosis in restricting positions, which can occur in swimmers with paralysis or paresis in their lower extremities. Under these conditions, physiotherapists establish functional re-adaptation exercise programmes, so that these people can recover and once again perform functions effectively, thanks to regular physiotherapy support programmes that are applied to specific sports and the modalities they perform[5,6].

From a technical point of view, the objectives of sports physiotherapy for people with or without disabilities depend on both the perspective of the trainer and the athlete[5], and depend on the discipline and anatomical-physiological characteristics of the athlete. However, in the case of athletes with disabilities these targets will also directly depend on their disability and the degree of the effects of this, and in

many cases on their movement system; walkers with great tendency to asymmetry on the longitudinal axis, or wheelchair users with an overload of the shoulders and arms as a basic element for movement. All of these aspects should be taken into account in personalised physiotherapy treatments.

We can establish the main objectives for these athletes:

- *Establishing preventive measures:* through a synergetic relationship between the trainer and the sports physician or team sports physician, to develop a working programme that minimises the risks of injuries and overloading, considering adequate preparation, the correct nutritional provisions and ideal physiotherapy care depending on the physical and mental capacities of each athlete. This objective is fundamental for them, as there are large anatomical areas (as mentioned above), with muscle-joint overload resulting from or as a consequence of the effect of these disabilities. As such, constant work is required from physiotherapy specialists, particularly for the shoulder and arms area for wheelchair users, and for the dorsal spine and lumbar region for all disabilities that may affect the longitudinal axis, among others.
- *Continuing treatment upon returning to competition:* the main aim of physiotherapy is to provide therapy without putting conventional medical treatments to one side; therefore, the athlete is supervised by a multi-disciplinary sports and medical team. Recovery from injuries will be quicker if this stage is monitored by an efficient and cohesive multi-disciplinary team, with the very latest medical knowledge, helping the athlete return as soon as possible to the sporting activities, regardless of his/her condition as an athlete without a disability, but especially for those with disabilities, it is important to ensure a return to everyday activities, which should be compromised as little as possible.
- *Sporting activation:* an athlete should follow a progressive sequence in the event of acquiring an injury. If the physiotherapist has done his/her job to prevent muscular atrophy, circulatory deficit and postural imbalances, particularly in athletes with disabilities in the areas where the effects have caused these aspects through lack of use, then the athlete with or without an injury can already return to activity, always under regular medical and physiotherapeutic surveillance.

  Within these final two physiotherapeutic objectives, once implemented and consolidated, we should assess the possible variations that these actions could represent for adaptability to the athlete's orthesis, prosthesis or wheelchair, which should always be re-assessed after these processes for returning to competition.

A knowledge and use of orthopaedic materials and technical supports, especially for athletes with motor disabilities, will be very important in the good bio-mechanical development of the sporting practice and movement. Currently, sporting prostheses and wheelchairs designed for the diverse Paralympic sports are already highly specific and unique[6]. We define Orthopaedic Sports Material as any instrument or apparatus that facilitates sporting movements and gestures for athletes with disabilities, in particular those with physical disabilities. Among the most representative are specific sports wheelchairs and prostheses for sporting application with an exoskeleton or functional design; also

Figure 1. Diverse sports prostheses and their servicing. Diverse competition wheelchairs with sport-specific adaptations (authors' private photo archive).

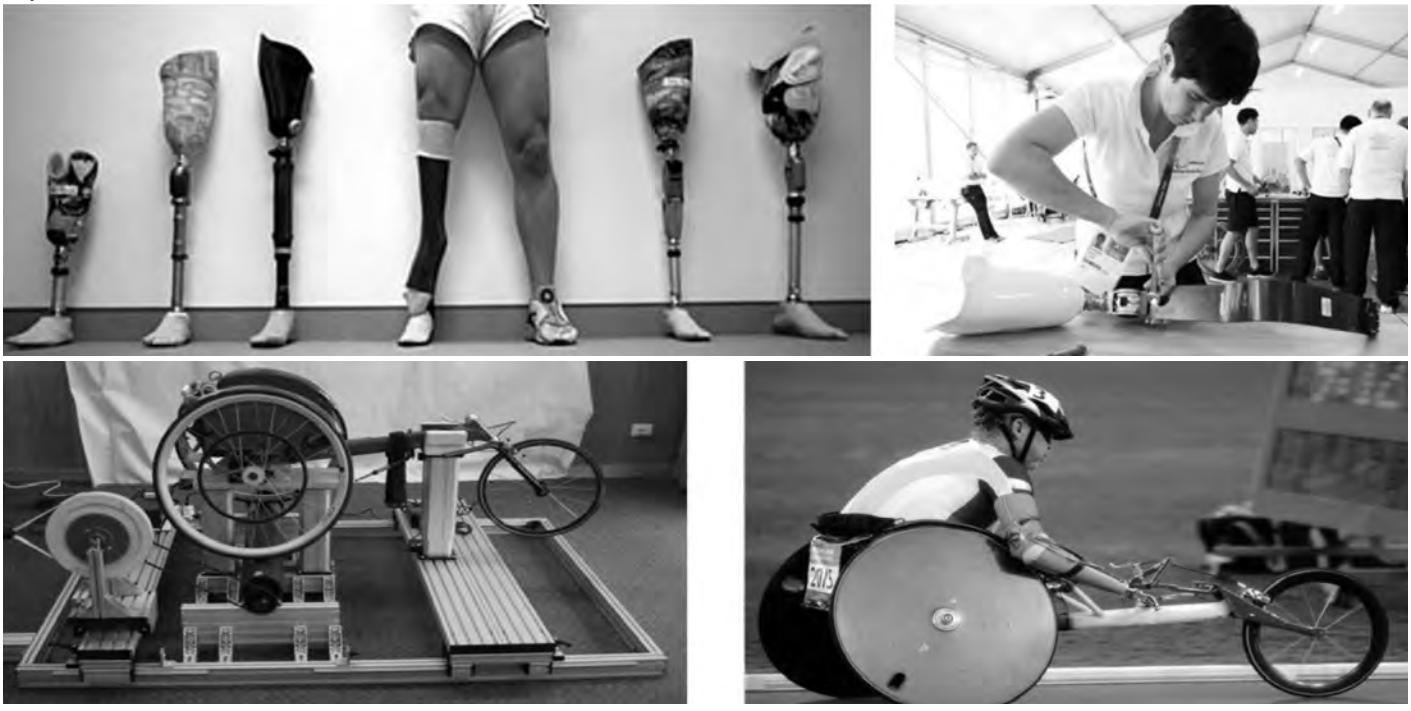
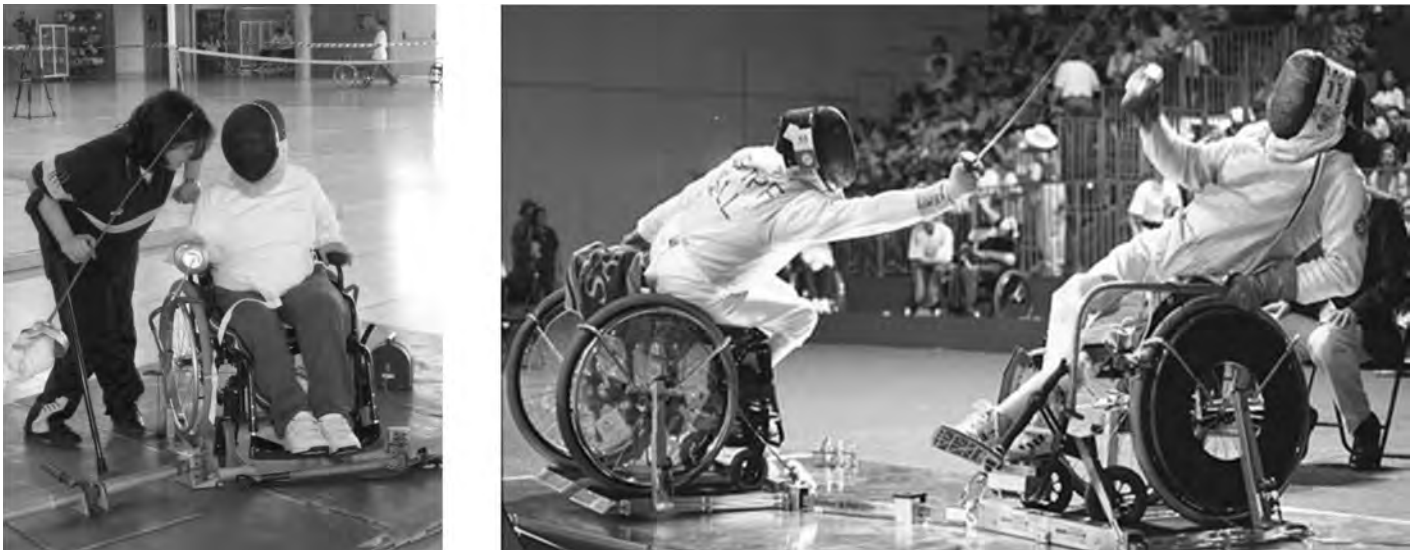


Figure 2. Wheelchair fixing devices for fencing in the wheelchair modality (authors' private photo archive).



included are sticks, crutches (safer in sporting practice), specific ortheses to facilitate mobility in sport, such as the so-called "stabilos", a mixture of a crutch, a ski pole and a ski tip for skiers with motor disabilities (Figure 1).

On the other hand, we define Technical Sporting Aids as the adaptations made to habitual sporting instruments or implements so they can be used in sporting practice for better performance and safety. In this case we could highlight the sticks attached to electrically-controlled wheelchairs for electric wheelchair Hockey players; the opaque masks for Goalball players with visual deficiencies; or the supports and special fixing devices used to secure wheelchairs during adapted fencing (Figure 2).

There are currently numerous specific sporting wheelchairs and functional sporting prostheses (Figure 1), in a range of different varieties and possibilities. For this reason, it is often necessary to count upon the support of specialised orthopaedic personnel, technical assistance, and enough maintenance and repair material to keep the support device suitable during sporting practice and to adapt it to the disability of the user

Healthcare assistance: in follow up and in competitions

Follow up healthcare assistance is usually organised into three types of basic functions: medical-sporting attention for athletes, regular anti-doping checks, and the establishment of ergogenic and/or nutritional support systems, with the latter two aspects favouring an improvement in specific sports performance, as mentioned in the first part of the review. Each sport has specific regulations regarding healthcare needs, which is why the curricular characteristics of the personnel in this field will depend on these. However, in cases of inclusion processes for athletes with disabilities, it will be very important for the medical specialist in physical education and sport to have support and active consultancy with specialised adapted sports physicians, in the previously mentioned aspects: doping, assessments, classifications, etc. As well as experts in the effects of the disability that these athletes may have, such as rehabilitation specialists, medullar injury specialists, amputation specialists, in the repercussions of cerebral palsy or head injury, and of course ophthalmologists, ENT specialists, and if necessary psychiatrists. Consultation with GPs could also be a good supporting platform for adequate federated sporting medical healthcare.

In terms of healthcare cover for sporting competitions, this review does not aim to provide a detailed identification of the elements and guidelines to develop within the competition healthcare organisation. Authors such as Moreno E, *et al* (2001)[7] on a general level, and Van de Vliet and Wilkinson (2015)[8], specifically for Paralympic competitions, already describe this issue in enough detail. We are merely going to highlight the probable presence in competitions of people with different disabilities, whether athletes, officials and managers, the public, family members and even media personnel, which could be major in competitions with the participation of adapted sport. This fact should be taken into account in the specific previsions of healthcare organisations. Sometimes this just requires making simple previsions such as providing wheelchair spaces for attendees; offering beds to help transfer athletes; or the participation of diverse healthcare specialists in the different effects depending on the type of competition and competitors. It is important to count on the collaboration of a reference hospital with specific healthcare units to provide specialised assistance depending on the disability, for example, the Medullar Injuries Unit, the Acute Brain Injury Unit, or the Ophthalmology Emergency Service, among others.

Journeys and travel

With the growth of the Paralympic Movement, athletes with different disabilities and degrees of affectation travel frequently to compete, often covering large distances. The needs required to prepare these journeys should be considered, with the aim of ensuring that these

athletes reach the competition in an optimum state of activation to guarantee their sporting success. We present various recommendations organised by the "tempus" and characteristics of the journey, applicable to all athletes in general, and specifically for the types of disabilities and their main effects.

Depending on the "tempus" and characteristics of the journey

- *Prior to the journey:* individual assessment of any restriction that could prevent the athlete from travelling so as to plan optimum sporting performance, medication requirements and possible administration during the journey. It is particularly important to review the use of any medication or ergogenic supplies that may require special conditions, such as refrigeration, or insulin syringes, among others. These actions also favour the review of possible medications or methods that require a Therapeutic Use Exemption (TUE), according to the World Anti-Doping Agency's (WADA) annually published list of banned substances and methods. Obtaining all the immunisations needed for the destination location should also be guaranteed. General reviews of the level of accessibility and the mode of transport, as well as the estimated length of the journey will also be necessary.

  Ensure beforehand that the athletes have all their necessary travel documents; including passports, a visa for the country they are travelling to (if required), medical insurance and vaccination history. Provide extra space for enough equipment and healthcare apparatus, technical support supplies and orthopaedic material to last the entire journey and stay. Take into account the time difference at the destination to calculate the need to take possible action beforehand to adapt to sleeping times and for possible medication administration times.

  Finally, make sure small amounts of medication and supplies are available during the journey, taking into account the current strict regulations on medication and the transportation of liquids, especially for air travel.
- *During the journey:* keep hydrated at all times and in all situations. The air used to ventilate aeroplanes is extremely dry and can cause dehydration. It is important to consider your personal preferences to find the right balance between suitable hydration and an excessive use of the bathroom facilities. Also, avoid alcoholic drinks that can be highly diuretic and dehydrating. For lengthy journeys, frequent hand washing is recommended to prevent infections. Whenever possible, athletes should keep mobile and perform quick stretching sessions and walk about. For athletes that cannot walk, upper body stretches are recommended, as well as short self-massages on the legs and arms to help the blood flow and the lymphatic system throughout the journey.

  Keep the distribution of medication and/or treatments to previously established intervals, ensuring the correct dosage at all times.
- *Once at the destination:* Monitor the amount of pollution and/or the air quality in the place of competition. This is important if the athlete is asthmatic or prone to respiratory diseases; this may require an adaptation of the bronchodilator dose. Help adjust the sleep/circadian cycle by applying the various guidelines previously established to these effects, and avoid light stimulation before sleeping (TV, tablet, computer screens), as this can make it harder to fall asleep.

  Fluid balance should be controlled. If the athlete's urine is darker or more concentrated upon arrival, the athlete should recover hydration as quickly as possible, until the urine is a clear, yellow colour.

Specifics regarding the type of disability and the degree of affectation

- *Athletes with effects from medullar injury, spinal bifida, poliomyelitis and other central or peripheral neurological effects:* use the pillow that is normally used whilst sitting. This can be particularly important for lengthy journeys to avoid pressure sores and ulcers. It is also recommendable to make small posture changes on the sitting supports every 30 minutes of the journey.

  For athletes that use them, check the state of the catheter and catheter equipment, and plan a time to control diuresis with catheterisation or catheters. This can be important on lengthy flights in which an aisle chair must be used for getting to the lavatory. For males the use of a condom catheter with a leg diuresis bag is considered appropriate to reduce the need to use the lavatory. If the athlete is prone to UTIs, the prescription of an antibiotic prophylaxis is considered acceptable before and during the travel period.

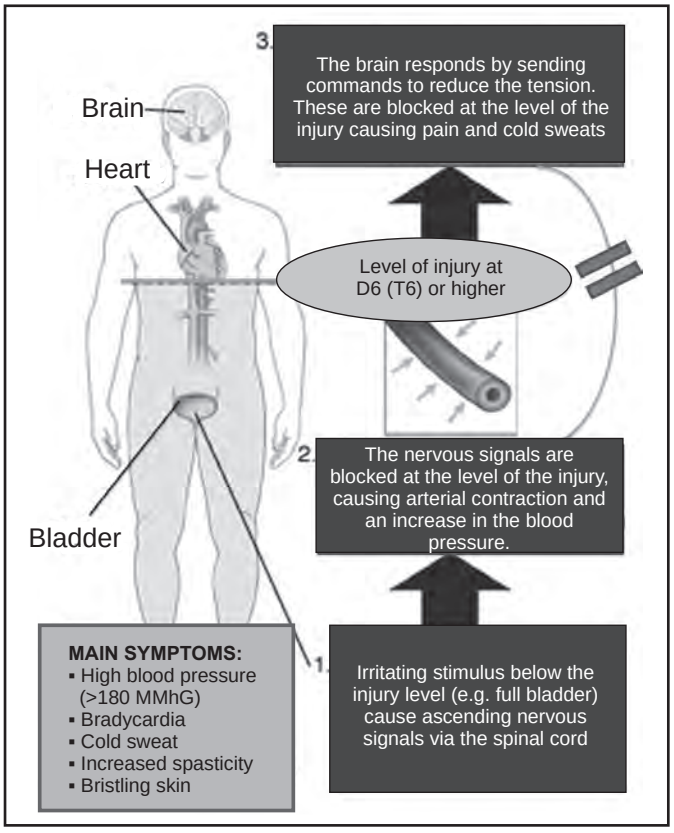
  An intestinal control programme should be planned around the time of travel and during the journey. If possible, defecating before starting the journey is recommendable, as this is more practical and easier when using public transport. Once the athlete reaches the destination, the intestinal programme times may require adjustment to work around the competitions.

  If there are athletes that suffer from spasms, these may occur more frequently due to tension and fatigue on a long journey. Check to see if this could be due to a neuro-sympathetic irritation below the level of the injury[9], which is common in athletes with medullar injury, due to possible folds in clothes under the area where the athlete is sitting, a trapped catheter or a full bladder. By alleviating the source of irritation, spasms may improve. If the spasms continue to worsen and are not alleviated using these methods, an anti-spasmodic pharmaceutical solution should be taken, particularly if the journey is very long.

  Due to the design of aeroplane seats, it is possible that the athlete will be sitting in a very upright position for hours on lengthy flights. This is frequently due to their reduced mobility, causing circulatory oedemas in the legs. In this case, the athlete should keep his/her legs raised during the journey. Special ascending compression stockings can also be used.

  Many athletes with medullar injury, particularly those with upper chest or cervical spine injuries, may present skin thermoregulation

Figure 3. Schematic representation of Autonomous Dysreflexia.



Adapted from Mazzeo F, Santamaria S, Iavarone A. "Boosting" in Paralympic athletes with spinal cord injury: doping without drugs." Funct. Neurol. 2015;30 (2):91.

disorders[9]. Aqueous mist spray bottles should be used to improve the body temperature. This can also be useful upon arrival and during the competition in hot regions. If the body feels cold, keep warm clothes or blankets to hand for a quick solution.

Athletes with medullar injury above vertebra D6 could be at risk of presenting Autonomic Dysreflexia (Krassioukov, 2012)[9], an uncontrolled reaction of the sympathetic nervous system due to harmful stimulus below the level of the injury, which cannot be controlled by the medullar injured athlete. Prevention will be the main tool for controlling it, avoiding possible irritating elements that can trigger it, such as tight, wrinkled clothing, late emptying of the bladder, among others. If dysreflexia symptoms appear, such as a headache, cold sweat, a possible increase in spasticity, nausea and/or vomiting, bristling skin and a significant increase in the systolic arterial tension, above 180 mm of Hg, with marked bradycardia, emergency action should be taken (Figure 3).

The first step is to locate and remove the stimulus, then place the athlete in the *"trendelembrug"* position and relax him/her; if this does not improve the haemodynamic situation, treat *"in situ"* with quick action vasodilators (Nifedipine 60 mgr. or Nitro-glycerine sublingually), remembering that the most serious cases can cause serious crises with epileptic contractions, visual impairment, stroke, collapse and death.

– *Athletes with amputation/s:* at a skin level and particularly in the area of the stump/s, take good care of the skin and check that there are no open wounds or areas of sores through contact. If the athlete wears a prosthetic limb, this could be removed for the majority of the journey if it is lengthy. If the athlete removes the prosthesis, correct distal irrigation should be guaranteed, raising the extremity and performing a gentle tissue massage to avoid problems with oedema when re-positioning it upon arrival.

As previously mentioned and due to the design of the seats, particularly in aeroplanes, swelling or oedema can develop in the limbs. This may be uncomfortable, and it can create problems when re-positioning the prosthesis/prostheses. Firm compression stockings can be used, which are extremely useful, preventing excess fluid from accumulating in the legs.

Structural adaptations

It is important, following the recommendations of the architect and accessibility expert Enrique Rovira-Belta Cuyas, to analyse the structural adaptations of the FMS, using their guide as a reference *"L'esport Inclou: Guia d'accessibilitat de material i ajudes tècniques per a centres esportius"* (2012)[10] to avoid accessibility barriers.

In the area around the FMS there should be parking spaces reserved for ambulances, medical vehicles and also, in particular, for users with reduced mobility[6]. These spaces should measure 5.00 m x 2.20 m for the vehicle in question, positioned in a row and with back clearance of 1.50 m to enable lateral transfer into and out of the vehicle, particularly for wheelchair users.

The FMS should have hydraulic beds with a minimum elevation height of 0.45 m to facilitate the transfer of all possible users, in particular for those with reduced mobility.

The floor surface should be hard, smooth and non-slip throughout, made of material that can be easily disinfected without damaging the surface features.

There should be two-way accessible itineraries in both directions, a minimum of 1.80 m wide to allow two competition wheelchairs to pass simultaneously. It is recommended that the different elements of an itinerary should be different colours so they can be easily distinguished: ground, ceiling, vertical furnishings, doors, etc.

Doors should be at least 2.10 m high and 0.90 m wide, and 1 m for competition wheelchairs. If there are two doors, one should measure at least 1 m wide.

Toilet facilities and possible nearby areas such as changing rooms should be equipped to perform anti-doping checks. Recommendations: there should be enough space to allow a turning circle measuring 1.50 m in diameter free from any obstacles, between the ground and 0.70 m height inside the accessible hygiene room. There should also be enough space to allow a turning circle measuring 1.50 m in diameter free from obstacles inside the booth, before the access door.

In order that these 2 spaces can be equipped to perform anti-doping checks, it is recommended:

- That the floor surface is non-slip.
- That the top part of the hand washing facilities are a maximum height of 0.85 m, free height below of 0.70 m minimum, and free depth below 0.50 minimum. Front access should be possible, without a step.
- Large mirrors, from 0.90 at the base (or moveable to a 10º vertical angle).
- Toilet positioned at a height of 0.45 – 0.50 m, with handrails as described previously. Lateral transfer space of at least 0.80 m, free from obstacles and 0.75 deep. In publicly used areas, a space to transfer on both sides, an accessible WC room. Steps are not permitted for toilets, apart from if they are part of the construction to achieve an accessible height.
- Urinals: if there are more than 5 units, at least one must be positioned at a height of 0.30 – 0.40 m from the base.
- Lighting: Lighting with timers is not permitted in accessible hygiene facilities.

Changing rooms should have the same features analysed as for hygiene facilities. The changing room should have enough internal space to permit a turning circle of 1.50 m in diameter free from obstacles, between the floor and 0.70 m of height. There should be individual accessible changing rooms, at least one for each sex, to allow the user and an assistant to enter, despite being of a different sex. Also, the external space of the booth should allow for turning circle measuring 1.50 m in diameter, free from obstacles, in the area before the door.

Technical adaptations

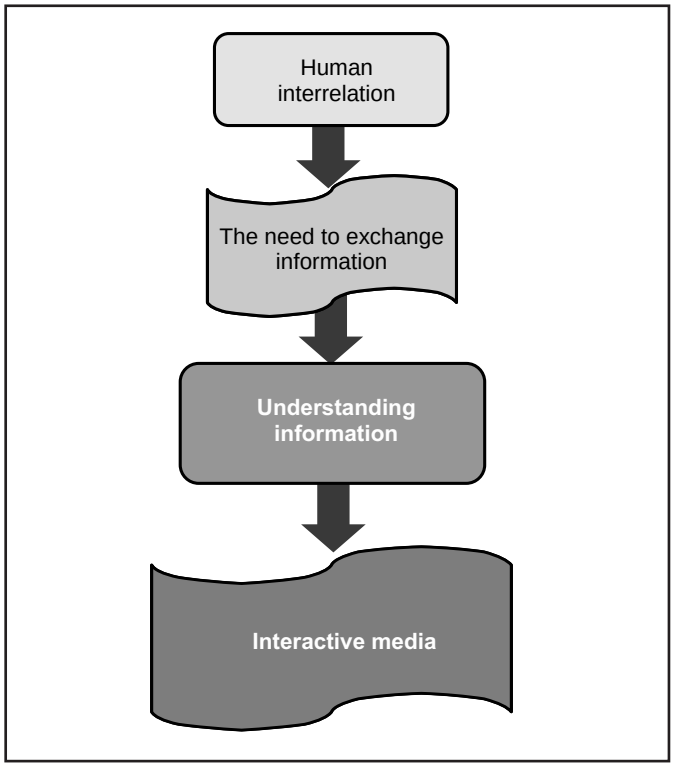
Represented by apparatus or equipment used for mobilisation, communication and information that favours the stay and access to all FMS: orthosis and prosthesis, anti-sore cushions, anti-decubitus mattresses, sticks, crutches, standing frames, walking frames, wheel chairs, cranes, seat and bed for bathing. Also, optical supports and electro opticals, Braille writing machines, sound recorders, peripheral devices, hearing supports, headphones, voice synthesisers and any other element that is duly justified.

Adapting communication and disclosure

For this kind of basic adaptation, the following elements are necessary:

- Information given via megaphone will be transcribed by sign-language interpreters in any events that require this service.
- Technical and human resources will be strengthened to make ordinary information and communication systems accessible.
- Sound amplification systems in: e-mail, fax, digital screens, information panels or similar, text telephones, information screens displaying the information given aurally via megaphone, among others.
- Sign language interpreters, headphones and magnetic circuits.
- Written signposting.
- Subtitling.
- Simultaneous interpretation.
- Picture codes.

Figure 4. Diagram of the elements of human communication.



Adapted from "Elementos para el Intercambio Comunicativo", in Otero, M.O. (2011). Support for institutions in receiving and welcoming dependent people.

According to Otero (2011) [11], in order for communication exchange to take place, the process should be linked to different elements, such as: mutual interaction, exchange of information, mutual understanding, and effective communication means and techniques (Figure 4). However, in specific cases of users with significant auditory impairments, serious communication disorders, multi-disabilities associated to brain damage, etc., adaptations are needed in diverse elements of the process to enable these individuals to participate in this circuit.

For example, sign language is a non-vocal communication method, so that deaf people can receive and exchange information with their surroundings using the sensorial visual channel and a gestural code, instead of the auditory channel and the use of spoken words. Other people with disabilities, such as those with visual impairments, need a different language code to the alphabet and its grammar, such as the "Braille" system.

Adapting sport psychology services

Psychological intervention in sport aims to contribute towards improving the mental conditions of everyone participating in this field: athletes, technicians, referees and judges, managers, parents or tutors, etc. This works in two senses: first, improved sporting performance linked to learning and the development of motor skills and mental abilities

to face the competition; and second, promoted health and well being, including psychological risk prevention that the activity could cause: competitive stress, interpersonal conflicts, burnout, etc.

The main mission of a sporting organisation is to meet the shared needs of everyone involved, which in inclusive sport are even richer and more varied. In terms of intervening to improve performance, psychology provides resources to train mental abilities, to plan training, to face events, to lead teams and to guide parents or tutors. In federations undergoing inclusive processes, even in the short term, functional diversity makes the day-to-day more complex, but in the mid term it strengthens results and the organisation's development. This added complexity calls for more specific knowledge, and psychology provides contents on the type and profile of the athletes and their particular adapted activity, as well as the transformation processes and the change of attitude across the entire organisation.

In the sports initiation phase, psychology helps develop attitudes and basic competencies for all children: effort, consistency, commitment with the activity, cooperation, etc. Functional diversity helps recognise both their own and external limitations. Therefore, experiences in inclusive education at school can be useful in the sporting sphere (Carbó and Giné, 2016)[12]. In the technification stage, psychology helps improve learning, especially of mental abilities, which in turn are transferred to fields such as study, work or life in general: attention and concentration, facing situations, tolerating frustration, developing a positive identity, etc. Functional diversity increases challenges, but in exchange, this situation can bring out psychological strengths, both in individuals and in groups. The psychologist can also analyse and help integrate competition systems and training methods, addressing the diversity of the group, facilitating cooperation-competitiveness processes in group work and team sports, and supporting the interdisciplinary aspects between sports techniques and those for adapted sports, as well as between other professionals (leaders, managers, etc.).

Inclusive sport requires the application of innovative knowledge and enhances excellence. For example, an athlete with a disability is a model for other companions to learn from. There are no major differences between the basic competencies of an athlete with or without a disability, but functional diversity offers all participants a greater chance of success, because it emphasises aspects that are often overlooked, such as: complementing each other and improving human impairments as a group, or transforming apparent impairments into a multiplying motivational factor. In this sport, the psychologist optimises the learning process of the whole group, whether by working directly with the athlete, or indirectly by training and collaborating with the technician. This task focuses on boosting specific processes, such as effort, motivation or self-confidence, which whilst shared among all people, require more effort when functional diversity multiplies. The technician should discover all the possibilities of each athlete, and the psychologist should complement this work and offer support[12]. In inclusive sport, cooperative work is even more necessary, which is returned in the general improvement of the organisation.

The psychologist contributes knowledge to assess and analyse interactions through methods of observation, records or interviews. In a psychology service, the psychologist also assists and guides the federative behaviour and complements the duties of other services. The FMS is one of these; as well as that of competition personnel (referees and coaches), for the design and application of regulations and competition rules. Their collaboration in functional classification processes is also interesting. By training technicians, psychology contributes knowledge about the evolution of the people involved, the disabilities – in particular mental or intellectual – and the diverse profiles of the athletes. The psychologist performs personalised follow-up, and adjusts mental resources, depending on the disability and experience of each of them. Finally, the psychologist provides guidance on how to treat the athlete, how to communicate with him/her and how to lead the group. The personalised work is an essential part of any kind of training and for any kind of athlete, in the search for their autonomy and ability to control themselves (Segura *et al*., 2016)[14].

The inclusive process, a one-way journey

Sporting practice has always been considered as an essential element for achieving good health, particularly among people with disabilities. If we want this demographic to have an integral development, we must include sport, outdoor games and physical exercise as essential aspects of achieving a good quality of life and full social normalisation.

The good development of competition sport for people with disabilities in an inclusive environment is based on two founding concepts: national and international legislation; and social awareness among both the demographic of people with disabilities and the rest of the population, particularly those that practice physical activity and sport regularly. Collectively acting upon the adaptation of pre-established social regulations and on social, general and specific attitudes in the sporting practice.

The first responsibility, within the legislative sphere, is of the State. The UNESCO International Charter of Physical Education and Sport, 21st November 1978[15], indicates sport as a fundamental human right and as essential for the development of peoples' personalities. Heading I of the Spanish constitution[16] states that sport is a fundamental factor in the formation and integral development of the personality, and constitutes a cultural manifestation that will be supported and promoted by public Spanish authorities. In Spain, the legislation regarding people with disabilities indicates their rights and liberties; these principles coincide with the *"International Classification of Impairments, Disabilities and Handicaps"* (WHO)[17], differentiating each one of the elements and understanding invalidity as "the disadvantaged situation of a specific individual as a consequence of an impairment or a disability that restricts or prevents the performance of a role that is considered normal based on age, sex and social and cultural factors".

Looking beyond legislative capacity, there are actions under the responsibility of other social organisations spanning from those of a

general nature to more specific ones, of sporting federations and sports clubs (Martínez-Ferrer, 2016)[4], with general federative actions being the most far-reaching for this review:

- Federative legal actions: that favour the development of single-sport federations and their sport.
- Federative management actions: targeting the organisation, management and driving of the federations, developing a new inclusive organisational culture.
- Actions in the inclusive dimension: favouring the inclusion or integration of athletes with disabilities, with normalisation criteria, and always respectful of diversity.
- Actions in the technical-federative sphere: with specific training for federated personnel, in our case for healthcare professionals who facilitate and guarantee the process.

In parallel to these, social actions should also be developed that favour synergies around federated sport, facilitating the inclusion/integration process, generating inclusive processes in spheres such as: a) inclusive school (and physical education classes in an inclusive environment); b) physical activities in their different modalities: health, leisure and free time, body expression, in a normalising environment and one that is respectful of diversity; c) raised awareness among the media regarding the values of sport, also represented by Paralympic athletes and the example they set.

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Recommendations for physical exercise in athletes with inherited heart diseases (first part)

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Summary

The safety of physical activity and sports in patients with inherited heart disease is not well established. The recommendations on physical exercise in these patients are usually quite restrictive without clear evidence for this, despite the fact that sport has shown important cardiovascular benefits. Participation in sports in adults with inherited heart disease is considered a relatively little known territory and many clinicians find it difficult to advise their patients. The development of current medicine has meant a significant improvement in the study of inherited heart diseases, as well as in their early diagnosis and treatment. In addition, genetic studies have assumed a fundamental aspect in the follow-up of these heart diseases, guiding more appropriately the therapeutic attitude that we must follow. Until recently, patients with such heart disease have been frequently disqualified from competitive sports, and in many cases, complete cessation of physical activity, including recreational sport, is recommended. However, current recommendations are less restrictive, insisting on individualizing the different cases depending on the type of pathology, the type of physical activity performed, whether they present the disease or are only carriers of causal genetic mutations, etc. Current research focuses primarily on the safety of physical activity in patients with inherited heart disease and the fear that the practice of competitive physical activity can significantly increase the risk of adverse events, especially arrhythmic events and sudden death. In this review, we analyzed numerous studies and clinical practice guidelines, in order to establish the recommendations of physical activity, as well as their restrictions depending on the different types of inherited heart disease.

Key words:
Sport cardiology.
Inherited heart disease.
Sporting activity.
Cardiomyopathies.
Channelopathies.

Recomendaciones para el ejercicio físico en deportistas con cardiopatías familiares (primera parte)

Resumen

La seguridad de la actividad física y deportiva en pacientes con cardiopatías familiares aún no está bien establecida. Las recomendaciones sobre el ejercicio físico en estos pacientes suele ser bastante restrictiva sin que haya clara evidencia para ello, a pesar de que el deporte haya demostrado importantes beneficios cardiovasculares. La participación en deportes en los adultos con cardiopatías familiares se considera un territorio relativamente poco conocido y muchos clínicos se encuentran con dificultades en el asesoramiento a sus pacientes. El desarrollo de la medicina actual ha supuesto una mejoría significativa en el estudio de las cardiopatías familiares, así como en su diagnóstico precoz y tratamiento. Asimismo, los estudios genéticos han supuestos un pilar fundamental en el seguimiento de estas cardiopatías, guiando de manera más adecuada la actitud terapéutica que debemos seguir. Hasta hace poco tiempo, los pacientes que presentan dichas cardiopatías han sido descalificados de manera frecuente de los deportes competitivos y en muchas ocasiones, se recomienda el cese completo de la actividad física, incluido el deporte tipo recreacional. Sin embargo, las recomendaciones actuales son menos restrictivas, insistiendo en individualizar los diferentes casos en función del tipo de patología, del tipo de actividad física realizada, si éstos presentan la enfermedad o son únicamente portadores de mutaciones genéticas causales, etc. Las investigaciones actuales se centran fundamentalmente en la seguridad de la actividad física en pacientes con cardiopatías familiares, y el temor a que la práctica de actividad física a nivel competitivo pueda aumentar significativamente el riesgo de eventos adversos, especialmente de eventos arrítmicos y muerte súbita. En esta revisión, analizamos numerosos estudios y las guías de práctica clínica, con el fin de establecer las recomendaciones de actividad física, así como sus restricciones en función de los diferentes tipos de cardiopatías familiares.

Palabras clave:
Cardiología deportiva.
Cardiopatías familiares.
Actividad deportiva.
Miocardiopatías. Canalopatías.

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Introduction

Inherited heart disease is the term used for a group of cardiovascular diseases (cardiomyopathies, channelopathies, certain aortic diseases, etc.) that share a series of common characteristics: they have a genetic base, a familial presentation, follow a heterogeneous clinical course and, finally, they can all be associated with sudden death[1].

The participation in sports of adults with inherited heart diseases is considered to be a relatively unknown area and many clinicians do not find it easy to advise their patients. The fundamental concern is based on patient safety and the fear that the practice of competition level sports could increase the risk of adverse events[2]: potentially lethal arrhythmias, sudden death, etc. However, in this field there is still no extensive experience to make it possible to establish definitive recommendations. Given the proven benefits of physical activity, it would be extremely restrictive to limit this population to purely recreational sports activities.

Until recently, patients with inherited heart diseases were frequently disqualified from competitive sports and, on many occasions, patients were recommended to completely stop physical activity, including recreational sports. However, we need to consider the disadvantages of the lack of physical exercise, predominantly in young people. For this reason, current recommendations are less restrictive, insisting on individualising the different cases, based on the type of pathology, the type of physical activity performed, whether they have actually developed the disease or are solely carriers of causal genetic mutations, etc.

In short, it is extremely important for physician to be aware and to know how to recommend an adequate level of exercise for these athletes, which offers the benefits of physical activity without increasing the risk of sudden death or other adverse events. Therefore, the current challenge would consist in ensuring that patients of this type can safely take part in regular physical activity. This review describes the recommendations for physical activity based on the different types of inherited heart disease.

Hypertrophic cardiomyopathy

Hypertrophic cardiomyopathy (HCM) is a hereditary autosomal dominant condition with a marked variation in phenotypic expression and a prevalence of 1:500 in the general population[3]. It is the prime cause of sudden death of athletes under the age of 35 in the United States and many European countries, such as Spain.

Although the presence of ventricular hypertrophy generally appears between the ages of 12 to 20, in some cases, it can also be detected at older ages. Likewise, it is relatively frequent that many carriers never develop the disease.

Intense exercise over prolonged periods of time has been shown to cause adaptive physiological changes (increase in the thickness of the walls, dilatation of the atria and right ventricle, etc.), which is commonly known as "athlete's heart". For this reason, it is essential to conduct an exhaustive study and to be particularly careful when establishing a diagnosis of HCM. This is because, on many occasions, we find ourselves in a grey area in which it is difficult to differentiate between adaptive changes and the presence of structural heart disease. Traditionally, the proposed limit for physiological adaptations is a wall thickness of less than 15 mm. However, different findings need to be studied, helping us to tip the scale and to establish a definitive diagnosis. Findings such as a reduction in the wall thickness with detraining, electrocardiographic changes, diastolic dysfunction, presence of a family history of sudden death, genetic study, etc.

Likewise, some works have described the appearance of myocardial fibrosis in some athletes subjected to a high sports load, favouring the appearance of ventricular arrhythmia[4]. In general, for HCM, there is currently little evidence to associate the intensity of exercise with the progression of the disease.

Today, echocardiography is considered to be the gold standard tool in the diagnosis of this pathology. This study makes it possible to estimate the level of hypertrophy, the ventricular function as well as the degree of obstruction of the left ventricular outflow tract (LVOT). We should point out that those factors affecting the systemic blood pressure (reduced pre-load and after-load) as well as an increase in myocardial contractility increase the degree of obstruction. Therefore, exercise generally increases the obstruction of the LVOT, when present. The exercise-related physiological changes produce an increase in the sympathetic activity, resulting in an increase in cardiac contractility and can lead to an increased obstruction of the LVOT. It has therefore been associated with increased symptomatology during exercise.

Today it has been described that only a minority of those patients having a set of symptoms for sudden death, actually die during exercise[5]; however, strenuous physical exercise is considered to be an important adverse event trigger. Moreover, while exercising, patients with HCM may develop an increased obstruction of the left ventricular outflow tract, myocardial ischaemia, diastolic dysfunction, etc. This can cause these athletes to exhibit important symptomatology such as exertional dyspnoea, angina or syncope. For this reason, faced with these symptoms, we need to rule out the presence of this disease.

In most cases, these cases of sudden death appear to be due to arrhythmic events (ventricular tachycardia, ventricular fibrillation, etc.). A number of articles establish that, for this pathology, the underlying electrophysiological substrate capable of triggering potentially lethal ventricular arrhythmias is unpredictable[6]. Many different triggering factors such as stress interaction resulting from competing, hydroelectrolytic disorders and the excessive discharge of catecholamine may play an important role.

To estimate the risk of sudden death, a score is available which assess the probability of the said adverse event occurring based on a series of criteria (family history, syncopal episodes, nonsustained ventricular tachycardia, etc.)[7]. If the said score gives a probability greater than 6% for sudden death after 5 years, then the implant of an implantable cardioverter defibrillator (ICD) is appropriate. To do so, it is necessary to conduct an exhaustive study of those patients with suspected hypertrophic cardiomyopathy, which should include a

transthoracic echocardiogram, 24-hour Holter monitoring, ergometry, cardiac resonance, etc.

Likewise, we need to take account of the fact that HCM patients could be at risk of sudden death even if they do not exhibit the conventional risk factors, although with a significantly lower incidence. In fact, high-intensity sports practice could in itself cause arrhythmic events, therefore acting as a powerful, modifiable and independent sudden death risk factor.

At present, it is complicated to apply these known risk criteria to competitive athletes with hypertrophic cardiomyopathy. The views expressed at the Bethesda conference of 2005[8] as well as those of the most recent American[9] and European[7] guidelines all have a strong similarity with regard to exercise restrictions in their recommendations, establishing that athletes with a probable or unequivocal diagnosis of HCM should not participate in competitive level sports. Thus, only low-intensity, low-dynamic and low-static (class IA) or leisure sports would be permitted. These recommendations are considered to be independent of a number of characteristics such as age, prior medical or surgical interventions, level of hypertrophy, type of mutation, etc. (class III, level of evidence C).

However, we should clarify that the possibility of a fully informed athlete with this pathology taking part in competitive sports would not be completely ruled out, provided that a joint multidisciplinary decision has been taken, basically between the athlete, the doctor and the sports organisation responsible.

For these athletes with HCM, drugs must not be administered (beta blockers, calcium antagonists, etc.) to alleviate the symptomatology or to prevent arrhythmic events, in order to participate in high intensity sports (Class III, level of evidence C).

Moreover, patients with an ICD are advised to follow the same restrictions as those that have no ICD. The implant of an ICD for the purpose of allowing these athletes to participate in high-intensity sports is not considered appropriate. We need to take account of the possible complications derived from the implant and monitoring of these devices (pocket haematoma, generator replacements, device infections, etc.). The indications for the implant of the ICD in competition sports should not be different for non-athletes with HCM (class III, level of evidence B).

At present, the performance of genetic studies is widely extended, leading to the frequent discovery of carriers of the family mutation who have not yet shown signs of the disease. In this regard, it is difficult to assess genotype positive-phenotype negative cases, in other words those healthy carriers of this disease who, even though they exhibit a genetic mutation, do not have ventricular hypertrophy or any other type of structural heart disease.

According to the current recommendations of the Bethesda Conference and the American Heart Association (AHA), asymptomatic patients with a positive genotype and who have not developed hypertrophy, with no family history of HCM-related sudden death or other risk factors, can participate in competitive sports (class IIA, level of evidence C). However, the European Society of Cardiology (ESC) is more restrictive in this respect, advising against their participation in competitive sports, while allowing them to participate in leisure activities.

Furthermore, for this patient subgroup, the recommendation is to assess ventricular hypertrophy by both transthoracic echocardiogram and cardiac magnetic resonance, given the fact that, in many cases (such as apical hypertrophic cardiomyopathy, etc.) this diagnosis may go unnoticed. Likewise, we need to take the different types of mutation into account, given the fact that the gene aggressiveness and the prognosis for the said pathology can be estimated on the basis of the variant.

With regard to the recommendation for sports activity, the ESC and the AHA establish similar recommendations for these patients[7,8]. Activities with an aerobic component (running, swimming, etc.) are primarily recommended with a light-medium intensity. Those sports with an intense static predominance (isometric) such as weightlifting, with potential rapid acceleration and deceleration should be avoided as there is an increased risk of induced LVOT obstruction due to the Valsava manoeuvre performed with this activity.

There is thus a need to consider the possibility of minimising the dynamic obstruction risk, the provocation of fatal arrhythmias and the progression of the disease. Moreover, there is a need to explain to athletes the importance of doing physical exercise in a suitable environment, given that adverse environmental conditions (excessive heat, dehydration, hydroelectrolytic disorders, etc.) could cause a greater risk of the aggravation of the induced symptomatology in relation to a reduction in the preload and afterload alike.

However, it has been described that exercise helps to improve the symptomatology of patients with HCM. These symptoms (dyspnoea, angina, syncope) typically occur during effort, probably related to diastolic dysfunction, cardiac insufficiency, etc. Studies exist which, although not specific to patients with this pathology, have demonstrated an improvement in the diastolic function and in the measured exercise capacity for oxygen uptake and quality of life after prolonged, regular physical exercise.

Dilated cardiomyopathy

Dilated cardiomyopathy (DCM) is generally characterised by the dilation and dysfunction of the left ventricle or, on occasions, of both ventricles. It can have a number of causes, such as aetiology of an idiopathic, genetic, metabolic, viral (prior myocarditis), alcoholic, ischemic nature, etc. Although not very frequent, dilated cardiomyopathy represents a cause of sudden death in the athletic population, predominantly due to lethal arrhythmic events.

An exhaustive study should be conducted on athletes with suspected dilated cardiomyopathy, including a physical examination, personal and family history, in addition to complementary tests: electrocardiogram, echocardiogram, 24 hour monitoring, ergometry, etc. In some cases, it is possible to identify the presence of supraventricular or ventricular tachycardias, conduction disorders, left bundle branch block, etc. For this reason, it is important to rule out the presence of arrhythmic events during the electrocardiographic monitoring, at rest and under effort.

It is currently considered that around 30-50% of dilated cardiomyopathies have a genetic or familial component[10]. Current guidelines do not recommend genetic studies for this population. However, in the index case, once a genetic dilated cardiomyopathy diagnosis has been established (or another type of cardiomyopathy), it would be useful to conduct a genetic study of relations, even if these are completely asymptomatic. Today it is described that, for certain more aggressive genes such as laminin, pathogenic mutation carriers show a higher incidence of adverse events[10], such as ventricular arrhythmias, sudden death, etc. at early ages, even without having developed a ventricular dysfunction.

Particular care should be taken in relation to the valuation of findings compatible with DCM, given the fact that it is essential to differentiate this disease from the physiological dilatation caused by high-performance training[11]. As mentioned above, prolonged aerobic exercise can cause the marked dilatation of the chambers of the heart, although this generally most frequently occurs at the expense of the right chambers.

There are a series of findings in the echocardiographic study that can help us to differentiate between the physiological adaptations of an athlete and the presence of this cardiomyopathy. For the DCM, for example, the ventricular cavity generally expands disproportionately in relation to the wall thicknesses, which are either normal or thinner (moreover, athletes frequently exhibit a slight increase in the ventricular walls). Likewise, systolic and diastolic dysfunctions are generally identified in athletes with this pathology, unlike the case of other athletes. The presence of significant valve diseases (for example mitral insufficiency due to cardiac remodelling, ring dilatation, etc.) or segmentation should direct us towards structural cardiomyopathy.

In certain cases, ventricular dilatation in athletes can be associated with a slight ventricular dysfunction. This can be explained by the fact that the increase in chambers produces a greater volume per beat, so that the ejection fraction at rest can either be at the lower limit of normality or slightly below it (<55%). To differentiate between both situations, it is extremely useful to use imaging techniques to evaluate the ventricular function during exercise (echocardiogram, heart gammogram, etc.). A significant increase in the ejection fraction would support the diagnosis of an "athlete's heart" while the lack of improvement in the ventricular function would direct us towards a pathological dilatation of the left ventricle.

Numerous studies have been published in which an analysis is made of the different echocardiographic findings in populations of elite footballers[12], objectivising that around 15% of trained athletes can have diastolic diameters of up to 70 mm in men and 60 mm in women. Likewise, the mean diameter is also generally at the high limit of normality, at around 55 mm, so we should not make a hasty diagnosis. The greatest ventricular dilatations are objectivised in men with a high body surface area, and in athletes practising sports with a high aerobic component (biking, marathon, etc.).

So, although there is little information available at the moment, the guidelines recommend that those symptomatic athletes with DCM, restrictive cardiomyopathy or cardiac infiltrative diseases (sarcoidosis, Fabry's disease, etc.) should not take part in most competitive sports with the exception of those of low intensity (class IA) in selected cases (Class III: level of evidence C). These recommendations are independent of the demographic characteristics, phenotypic appearance, and they do not differ for those asymptomatic athletes or those that have received prior treatment with drugs, surgical interventions or an ICD implant. Likewise, as mentioned above for hypertrophic cardiomyopathy, the presence of an ICD in high level sporting events must not be considered as either primary or secondary prevention, and should not be a justification for athletes with DCM to participate in competitive sports.

Arrhythmogenic right ventricular dysplasia / cardiomyopathy

This is considered to be a primary myocardial disease histologically characterised by the fibroadipose replacement (fatty tissue) of the ventricular myocardium (predominantly the right one). This is a disease of the desmosome generally resulting from the mutation of defective cell adhesion proteins. From a clinical point of view, it usually appears as potentially lethal ventricular tachyarrhythmias in young individuals, in most cases it is associated with exercise and participation in sports.

This pathology has been traditionally known as arrhythmogenic right ventricular cardiomyopathy/dysplasia (ARVD/C). However, for some years now, it has also been termed "arrhythmogenic cardiomyopathy" due to the fact that both ventricles are frequently affected or, even on some occasions, only the left ventricle. It is estimated that ARVD/C affects 1 in every 1,000 - 1,250 individuals[13], although it is possible that there is a certain infradiagnosis due to the difficulty in detecting it in asymptomatic individuals or with slight symptoms, with sudden death being its first manifestation. ARVD/C is usually inherited as an autosomal dominant disorder. However, the phenotype of this disease is widely variable, with certain patients who, despite exhibiting the mutation and the disease, do not strictly meet the criteria.

ARVD/C currently represents the most frequent cause of sudden death in athletes under the age of 35 in Italy[14]. Today, the identification of ARVD/C is a great challenge, particularly with regard to asymptomatic individuals. Its diagnosis basically depends on the presence of a family history, electrocardiogram alterations or right ventricular morphological abnormalities using different imaging techniques. Nowadays, there are a series of minor and major criteria that help us to establish the definitive diagnosis[15]. Thus, based on the minor and major criteria presented by the patient, we can consider that the patient has definite ARVD/C, borderline ARVD/C, or possible ARVD/C. We should take into account the fact that a carrier of a mutation related to this pathology constitutes in itself a major criterion in the diagnosis. Therefore a carrier of these mutations would already have a possible diagnosis of ARVD/C[15].

Some experimental experience exists for animals (mice) and observational experience for athletes, in connection with physical exercise increasing the risk of developing the disease (penetrance) and the arrhythmic risk in healthy carriers. This has been demonstrated both in high performance sport and in moderate leisure physical activity.

With regard to the performance of diagnostic tests, the electrocardiogram proves highly useful in its identification, given the fact that different electrocardiographic anomalies (inverted T waves in right precordial leads, epsilon wave, etc.) may be present in 50% of patients. Likewise, on many occasions, these electrocardiographic findings may precede the clinical manifestations of the disease. However, we need to exercise particular care when using this tool to make the diagnosis, given the fact that multiple findings frequently encountered in athletes, such as the incomplete right bundle branch block, negative T waves in V1-V3, etc. could simulate this pathology.

The premature ventricular ectopic beats and ventricular tachyarrhythmias usually have a left bundle branch block morphology (given that the ectopic focus generally comes from the right ventricle) and are frequently associated with exercise. Therefore, ergometry is an essential test that will help us in the diagnosis and risk stratification of this disease.

Today, for the definitive diagnosis of arrhythmogenic cardiomyopathy, imaging techniques are an essential tool. The echocardiogram offers us a considerable amount of information, given the fact that it allows us to identify the marked dilatation or dysfunction of the right ventricle which must lead us to suspect this pathology. However, the use of this technique to evaluate the morphological study of the right ventricle requires greater validation, due to the localised extension of morphological abnormalities, poor ultrasound windows, etc. For this reason, the detection of abnormalities in the contractility or dimensions of the right ventricle in the echocardiogram often has a limited diagnostic value.

Today, cardiac magnetic resonance imaging is the gold standard tool for the definitive diagnosis of ARVD/C. This technique has greater spatial resolution and therefore allows us to make an exhaustive study of the presence of right ventricular dysfunction as well as localised morphological abnormalities such as aneurysms, dyskinesias or the thinning of the right ventricular free wall. Furthermore, this test allows us to identify areas of fibrosis or the fibrofatty replacement of the ventricular wall. As mentioned earlier, we must not forget the evaluation of the left ventricle in the study of this pathology.

Likewise, we should remember that high-resistance athletes, predominantly with a greater aerobic component, may exhibit a marked dilation of the heart chambers (predominantly the right ones) as a consequence of the significant cardiac remodelling resulting from their high performance training[12]. There are certain criteria that can help to distinguish between physiological adaptations and findings compatible with arrhythmogenic cardiomyopathy. Athletes show normal right ventricular wall thicknesses with no dyskinetic or aneurysmatic areas. The absence of dysfunction, delayed enhancement or fatty tissue would go in favour of physiological adaptations related to an "athlete's heart".

A genetic study must be conducted on those athletes with a highly suspected presence of arrhythmogenic cardiomyopathy. Today, the mutation of the PKP2 gene is the principal cause of this pathology, with a prevalence of mutations in index cases of up to 43%[15]. However, as outlined in the literature, only 30% of these cardiomyopathies exhibit an identification of the causal mutation.

In short, the current recommendations for patients with this pathology are:

- Athletes with a definite diagnosis of ARVD/C should not participate in most competitive sports, with the possible exception of low-intensity sports (IA) (Class III: level of evidence C), proven absence of symptoms or arrhythmias related to exercise.
- Athletes with a borderline diagnosis of ARVD/C should not participate in most competitive sports, with the possible exception of low-intensity sports (IA) (Class III: level of evidence C).
- Athletes with a possible diagnosis of ARVD/C should not participate in most competitive sports, with the possible exception of low-intensity sports (IA) (Class III: level of evidence C).

These recommendations are also independent of age, gender and phenotypic appearance and do not vary from asymptomatic athletes, or those treated with drugs, surgical interventions, ablation or ICD implant. Likewise, the prophylactic implantation of a defibrillator in patients with ARVD/C should not be made for the simple purpose of participating in high-intensity sports, due to the possible complications derived from the implantation of these devices. (Class III; level of evidence C).

Non-compaction cardiomyopathy

Non-compaction cardiomyopathy (NCC), also called spongiform cardiomyopathy, is a genetic-based cardiomyopathy that is due to the arrest of the embryonic myocardial development[16], characterised by the presence of a left ventricular hypertrabeculation. As this entity has only recently been described within the history of cardiology, at the time being there are no extensive studies that make it possible to apply a special risk stratification for athletes.

Its diagnosis is doubtful in many cases, and it therefore entails a certain difficulty in studying IT. For this reason, different criteria are used to help us try and establish a definitive diagnosis[17]:

- TT echocardiograms, the use of validated criteria (marked trabeculae, more than three, with a compacted - non-compacted myocardium ratio greater than 2 (in systole), trabecular perfusion, etc.
- Cardiac magnetic resonance: nowadays it is established that there should be a ratio between non-compacted and compacted layers of more than 2.3 (diastole), trabeculated IV mass of more than 20% of the normal VI mass, etc.
- Genetic test, neurological evaluation, screening in first degree relatives, etc.

The transthoracic echocardiogram and electrocardiogram are currently used as the main tools to establish an initial diagnosis. However, magnetic resonance imagining is recommended for suspected cases of NCC, given the fact that it offers greater image resolution and therefore helps in the myocardial qualitative study and in the evaluation of the non-compacted layer.

However, the actual sports-related ventricular remodelling can simulate different cardiomyopathies, particularly the non-compacted cardiomyopathy. Although the most frequent physiological adaptations

consist in an increase in the diameters of the chambers and wall thickness, exceptionally we could find a case of a marked hypertrabeculation, which is generally more frequent in the left ventricular apical segments.

In a Spanish study of more than 6,000 athletes[18], the echocardiogram only revealed the presence of 6 cases of hypertrabeculated myocardium, with a proportion of compacted/non-compacted greater than 2 in the telesystole. In all these cases, the segments affected were normocontractile and presented a conserved ventricular function. Likewise, no structural cardiopathy was detected in first-degree relatives for any of these athletes.

This study concluded that the absence of symptomatology and family history and also the absence of alterations in the complementary study (electrocardiogram, echocardiogram, etc.) should make us doubt the diagnosis of NCC. We should therefore be aware that myocardial trabeculation could be an uncommon form of adaptation to intense exercise in certain predisposed individuals.

So, we know that there are severe forms of the disease, particularly in patients with symptomatology, family history or known genetic mutations, where it is simpler to make a definite diagnosis. However, there are generally serious problems in those minor forms, particularly in high-level athletes. Other populations for which the said hypertrabeculation findings are described could be: black athletes, patients with sickle cell anaemia, etc.

Likewise, great genetic heterogeneity has been described for this pathology with different inheritance patterns and an overlapping with other cardiomyopathies, particularly with dilated cardiomyopathy and hypertrophic cardiomyopathy. There are currently no long term studies on the evolution of athletes with NCC. As a result, no criteria have been established with regard to the risk of sudden death that could be applied to competition athletes. For this reason, there is very little evidence on this disease and its natural history still remains unknown, particularly for those with a normal systolic function.

Current recommendations establish that, until more relevant clinical information is available, asymptomatic patients with an NCC diagnosis and conserved systolic function, with no important ventricular arrhythmias in the ambulatory monitoring or in the effort test, and with no unexplained syncope history, can participate in competitive sports (Class IIB, level of evidence C).

However, the very presence of one of these parameters in these patients would exclude the athlete from competing. In other words, those athletes with a clear diagnosis of NCC with systolic dysfunction or important atrial and ventricular arrhythmias in the ambulatory monitoring or in the effort test (or history of syncope) must not participate in competitive sports with the exception of low-intensity sports (class IA), at least until there is more clinical information (Class III: level of evidence C).

Marfan syndrome

Marfan syndrome is a dominant autosomal hereditary disease that generates an alteration of connective tissue, producing different levels of affectation: cardiovascular, ocular, musculoskeletal or pulmonary. It has an estimated prevalence of around 1 in every 5,000 live births[19].

The cardiovascular manifestations are of particular interest, given the fact that they entail a high risk of sudden death for individuals with this condition. The most frequent manifestations are aortic root dilatation, mitral valve prolapse, coarctation of the aorta or the CIA. On the other hand, the worst finding is aneurysm or aortic dissection.

Approximately 60% of patients with Marfan syndrome exhibit aortic root dilatation, predominantly males. In general, medical treatment for these patients is based on avoiding aortic root dilation and dissection by endeavouring to reduce blood pressure and cardiac inotropism. Treatment with beta blockers[20] has been widely recommended in a number of studies in order to prevent the progressive dilatation of the aorta. Moreover, recent studies have focussed on the use of ARA II (angiotensin II receptor antagonists) to antagonise TGF-B signalling, involved in the aortic root dilatation in Marfan syndrome.[21].

Currently, the revised Ghent criteria are used for the diagnosis of Marfan syndrome (Table 1)[22]. The transthoracic echocardiogram and the CAT/MR scan of the thorax are the basic tools to assess the cardiovascular impact. Stable patients require an annual check-up with an echocardiogram. A CAT/MR is recommended every 5 years if there is no aortic dilation. In the event of aneurysm or aortic dilation, these imaging tests should be conducted on an annual basis[23].

Given the greater vulnerability of patients with this disease, the limits for intervention and surgery are different from those of the general population. With regard to surgical repair, according to the 2014 European guidelines on the diagnosis and treatment of the pathology of the aorta, surgery is recommended for patients with Marfan syndrome and a maximum aortic diameter greater than or equal to 50 mm, or else 45 mm if there are risk factors such as family history of dissection, growth > 3mm/year (in various examinations using the same technique and with confirmation in another), serious aortic regurgitation or childbearing intention. Patients exhibiting Marfanoid manifestations due to connective tissue disease, with incomplete Marfan criteria, must be treated as patients with Marfan.

With regard to the participation of athletes with Marfan syndrome, the most important consideration is the early detection of individuals with this condition. Athletes with a Marfanoid phenotype or with family history must be examined immediately to rule out this pathology prior to commencing sporting activity. More aggressive screening strategies are recommended for sports that are typically practised by athletes with this specific profile and a certain Marfanoid habit, such as basketball and volleyball. Given the fact that the prevalence of Marfan syndrome is generally higher in this population, the screening of these high-risk groups could improve the early detection of this pathology and prevent the progression of the disease among these athletes.[24].

Today, important restrictions on physical activity have been established for patients with Marfan syndrome. For example, activities involving collisions or intense contact sports are considered to be of particularly high risk for these individuals, given their cardiovascular and

Table 1. Diagnostic criteria of the Ghent nosology for the diagnosis of Marfan Syndrome.

Organ/System	Requirements for the classification of major criteria	Requirements for the affectation of organ/system
Skeletal	At least four of the following: 1. *Pectus carinatum* 2. *Pectus excavatum* requiring surgery 3. Reduced upper to lower segment ratio or arm span to height ratio (<1.05) 4. Positive wrist and thumb signs 5. Scoliosis (20º) or spondylolisthesis 6. Reduced extension at the elbow (<170º) 7. Medial displacement of the internal malleolus causing flat feet. 8. Protrusio acetabuli	At least two major criteria findings or one from this list and two from the following minor criteria: 1. *Pectus excavatum* of moderate severity 2. Joint hypermobility 3. High arched palate or crowding of teeth 4. Characteristic facial appearance (dolichocephaly, malar hypoplasia, enophthalmos, retrognathia, down-slanting palpebral fissures).
Ocular	Ectopia *lentis*	At least two of the following minor criteria: 1. Abnormally flat cornea 2. Increased axial length of the ocular globe 3. Hypoplastic iris or hypoplastic ciliary muscle causing decreased miosis
Cardiovascular	At least one of the following: 1. Dilation of the ascending aorta with or without regurgitation, involving the sinuses of Valsava 2. Dissection of the ascending aorta	At least one of the following minor criteria: 1. Mitral valve prolapse with or without regurgitation 2. Dilatation of the pulmonary artery, in the absence of stenosis or other cause in individuals under the age of 40 years 4. Dilatation or dissection of the descending thoracic or abdominal aorta in individuals under the age of 50 years.
Pulmonary	None	At least one of the following minor criteria: 1. Spontaneous pneumothorax 2. Apical blebs
Teguments	None	At least one of the following minor criteria: 1. Stretch marks not associated with marked weight changes, pregnancy or repetitive stress. 2. Recurrent or incisional hernia
Dura	Lumbosacral dural ectasia	None

For the diagnosis of Marfan Syndrome in patients with no family history of the disease, two organs / systems must be involved which comply with the criteria and at least an impact on a third organ / system. For patients with a family history of Marfan Syndrome, only one major criterion is required, with data that suggest the involvement of a second system (De Paepe, *et al*).

skeletal sensitivity. Likewise, athletes who are carriers of this syndrome should not perform high-risk activities, or at least try and minimise their exposure to activities of this type (class III; level of evidence C).

With regard to current recommendations, isometric exercises should be prohibited for athletes with Marfan syndrome, given the damaging haemodynamic effects of increased aortic wall tension, leading to a considerable increase in the risk of aortic dissection or rupture. According to the recommendations established in the 36th Conference of Bethesda[8], these athletes should only practice low-intensity activities with a low dynamic and static component (such as rambling, bowling, golf, etc.). Likewise, the more recent American recommendations (AHA 2015)[9] establish that patients with this syndrome can practice type IA or IIA sports (Class I; level of evidence C) if they do not have more than one of the following characteristics: aortic root dilation (Z score >2, 40 mm or >2 DS children and minors under 15), moderate-severe mitral insufficiency , left ventricular systolic dysfunction (FEVI<40%) and/or family history of aortic dissection with diameter <50 mm.

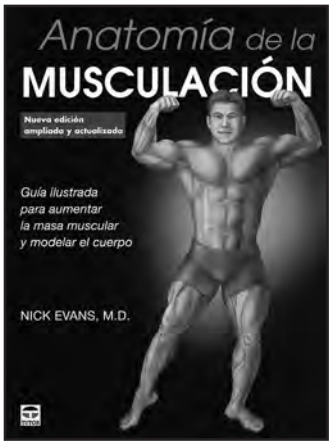
The bibliography is published in the second part of the work.

101 EJERCICIOS DE ENTRENAMIENTO DE FÚTBOL PARA JÓVENES. Volumen 2

Por: Tony Charles y Stuart Rook
Edita: Ediciones Tutor-Editorial El Drac.
Impresores 20. P.E. Prado del Espino. 28660 Boadilla del Monte. Madrid.
Telf: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2018, 128 páginas, P.V.P.: 10,95 euros

Esta obra busca ser un manual imprescindible para los entrenadores de fútbol juvenil. Este utilísimo segundo volumen de "101 ejercicios de entrenamiento de fútbol para jóvenes", contiene: calentamientos, ejercicios para el entrenamiento de destrezas específicas, juegos divertidos y partidillos de finalización de entrenamientos.

Todos los ejercicios son divertidos, formativos y con cierto grado de exigencia. En cada uno se detalla información clara sobre el equipamiento y el espacio necesarios, sobre la disposición de los jugadores y sobre cómo adaptar los ejercicios a su habilidad. En ellos también hay consejos claros sobre los puntos relevantes para el entrenamiento. Cada ejercicio está diseñado en conexión con otros que aparecen en el libro con el fin de ofrecer una combinación de más de 80 sesiones de entrenamiento completas, dinámicas y efectivas

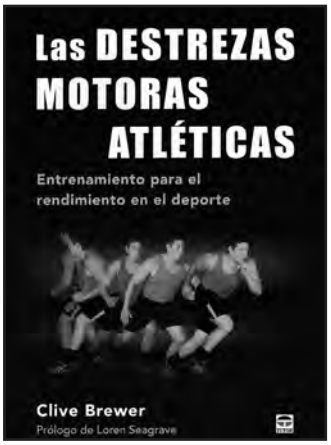


ANATOMÍA DE LA MUSCULACIÓN. Nueva edición ampliada y actualizada

Por: Nick Evans
Edita: Ediciones Tutor-Editorial El Drac.
Impresores 20. P.E. Prado del Espino. 28660 Boadilla del Monte. Madrid.
Telf: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2018, 240 páginas, P.V.P.: 29,95 euros

Esta guía ilustrada para aumentar la masa muscular y modelar el cuerpo, con detalladas ilustraciones anatómicas a todo color de los músculos en acción en cada ejercicio e instrucciones paso a paso sobre su correcta ejecución, es el recurso ideal para ganar masa muscular y lograr la definición de los músculos deseada. Se centra en los grupos musculares principales de los hombros, pecho, espalda, brazos, piernas y abdomen, y en las zonas y áreas musculares más difíciles de trabajar.

En esta nueva edición ampliada y actualizada de su libro, el Dr. Nick Evans incluye 100 ejercicios principales, junto con 104 variaciones, para asegurar que el lector logre los resultados que necesita cuando, donde y como quiera. También se busca vaya más allá de los ejercicios para ver los resultados en acción. Las ilustraciones de los músculos activados en las poses más populares de culturismo muestran cómo cada ejercicio está fundamentalmente vinculado con la competición.



LAS DESTREZAS MOTORAS ATLÉTICAS

Por: Clive Brewer
Edita: Ediciones Tutor-Editorial El Drac.
Impresores 20. P.E. Prado del Espino. 28660 Boadilla del Monte. Madrid.
Telf: 915 599 832 - Fax: 915 410 235
E-mail: info@edicionestutor.com Web: www.edicionestutor.com
Madrid 2018, 448 páginas, P.V.P: 49,95 euros

El tema unificador de todo atleta de élite y de cualquier rendimiento espectacular es el movimiento. Es el fundamento de las destrezas atléticas y el ingrediente esencial de la excelencia. Este libro establece un nuevo estándar en la evaluación y el desarrollo atlético. Este trabajo ofrece protocolos probados para la valoración, corrección, entrenamiento y traducción del movimiento atlético al dominio deportivo.

Cientos de secuencias fotográficas e ilustraciones, además de 10 progresiones detalladas de ejercicios, describen cómo entrenar y perfeccionar la velocidad, la agilidad, la fuerza y la potencia en relación con el movimiento y las destrezas. Tanto si se trabaja con deportistas jóvenes o experimentados, principiantes o de élite, este libro será imprescindible. Es la guía definitiva de progreso para todo aquel que se dedique formalmente al rendimiento deportivo.

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XVII CONGRESO INTERNACIONAL DE LA SOCIEDAD ESPAÑOLA DE MEDICINA DEL DEPORTE

FUERZAS ARMADAS – SOCIEDAD
Una alianza a través de la actividad física y el deporte

Toledo - Hotel Beatriz Toledo Auditórium
29-30 de noviembre y 1 de diciembre de 2018

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Sociedad Española de Medicina del Deporte

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PROGRAMA PRELIMINAR

JUEVES, día 29

SESIÓN PLENARIA: El pasado y el presente de la traumatología del deporte.
Moderador: **José Cotarelo Perez**

José María Vilarrubias Guillamet
Mikel Sánchez Álvarez

PONENCIA OFICIAL de la Agencia Española de Protección de la Salud en el Deporte (AEPSAD): El Pasaporte Biológico del Deportista (PBD), presente y futuro.
Moderador: **José L. Terreros Blanco**

El PBD como herramienta en el control de dopaje
Jesús A. Muñoz Revilla

El PBD, una visión desde la Medicina del Deporte
Pedro Manonelles Marqueta

El PBD, una visión jurídica
Agustín González González

PONENCIA OFICIAL: Patología del pie en el deporte.
Moderador: **Ángel González de la Rubia Heredia**

Valoración de la morfología, rigidez y función del arco del pie en el corredor.
Luis Enrique Roche Seruendo

Talalgias en el deportista. Abordaje clínico.
Alfonso Martínez Franco

Dolor aquileo: las lesiones del tendón más poderoso.
Sergio Tejero García

PONENCIA OFICIAL: Probióticos y deporte.

SIMPOSIO SETRADE: Gestión de la información en las lesiones deportivas.
Presidente: **Antonio Carrascosa Cerquero**
Moderador: **Carlos Sánchez Marchori**

El menor deportista de élite. Cómo y a quién informar
Cristóbal Rodríguez Hernández

Ética en la gestión de la información
Tomás Fernández Jaén

El médico de equipo y su relación con los medios
Jordi Ardevol Cuesta

SIMPOSIO: Alimentación en situaciones extremas.

La alimentación del ejército en operaciones de campaña.
Juan Manuel Ballesteros Arribas

La alimentación en la travesía del Atlántico a remo.
Jorge Pena Mariño

La alimentación en altitud extrema.

TALLER: Taller de interpretación del electrocardiograma en el deportista.
Emilio Luengo Fernández

VIERNES, día 30

SESIÓN PLENARIA: El futuro del alto rendimiento deportivo/ *The future of high sports performance.*
Moderador: **José Naranjo Orellana**

El maratón en menos de dos horas:
The Sub2 Marathon Project: Galileo contra Goliat.
The Sub2 Marathon Project: Galileo versus Goliath.
Yannis Pitsiladis

Algoritmos de predicción de récords deportivos.
Sports record prediction algorithms.
John H. J. Einmahl

PONENCIA OFICIAL: El entrenamiento de la fuerza y la fatiga.
Moderador: **Fernando Alacid Cárceles**

Entrenamiento de fuerza y fatiga.
José Manuel García García

Entrenamiento adecuado para soportar la fatiga en colectivos especiales.
Nuria Mendoza Laiz

Alimentación adecuada para soportar la fatiga.
Antonio López Farré

PONENCIA OFICIAL: Actualización en deporte adaptado.
Moderador: **Antonio Sánchez Ramos**

Principales adaptaciones de los servicios médicos a la inclusión deportiva en el deporte federado.
Josep Oriol Martínez Ferrer

Baloncesto en silla de ruedas en España: aplicaciones inclusivas y de investigación.
Javier Pérez Tejero

Deporte terapéutico en lesionados medulares.
Ana Esclarín de Ruz

PONENCIA OFICIAL: Ejercicio físico en el ámbito militar.
Moderador: **Juan Ramón Godoy López**

Ejercicio físico en condiciones extremas en militares de operaciones especiales.
Claudio Nieto Jiménez

Hacia un nuevo modelo de preparación física militar.
José Francisco García Marco Reclamado

Entrenamiento físico del personal de vuelo.
Carlos Velasco Díaz.

SALA SEGUNDA
SIMPOSIO: Terapias no invasivas en la tendinopatía calcificante del hombro.
Moderador: **Miguel Del Valle Soto**

Electroterapia.
Juan Nápoles Carreras

Ejercicio.
Fernando Ramos Gómez

Ondas de choque.
Óscar Sanjuán Reguera

PRESENTACIONES

Documento de consenso de la Sociedad Española de Medicina del Deporte (SEMED-FEMEDE) sobre contraindicaciones para la práctica deportiva.

Documento de Consenso de la Sociedad Española de Medicina del Deporte (SEMED-FEMEDE) sobre lesiones y accidentes deportivos.

Documento de Consenso de la Sociedad Española de Medicina del Deporte (SEMED-FEMEDE) sobre ayudas ergogénicas.

TALLER: Taller de interpretación de la prueba de esfuerzo.
José Naranjo Orellana

SÁBADO, día 1

SESIÓN PLENARIA: ¿Hacia dónde se dirige la nutrición en el deporte y en la actividad física?

La alimentación en el deporte y el ejercicio / *Nutrition for sports and exercise*
Ron Maughan

El futuro de la nutrición en la actividad física.
Luis Moreno Aznar

PONENCIA OFICIAL: Ética y deontología en Medicina del Deporte: La clasificación deportiva de deportistas con diferencias en el desarrollo sexual.
Presentación: **Pedro Manonelles Marqueta**

La visión desde la Deontología Médica
Juan José Rodríguez Sendín

La visión desde la Medicina del Deporte
Fabio Pigozzi

REMISIÓN DE COMUNICACIONES CIENTÍFICAS

El Comité Científico invita a todos los participantes a remitir comunicaciones científicas (comunicaciones orales y póster-presentación interactiva) al XVII Congreso Nacional de la Sociedad Española de Medicina del Deporte.

Temas para presentación de Comunicaciones Científicas en el Congreso:

- Medicina del deporte.
- Entrenamiento y mejora del rendimiento.
- Biomecánica.
- Cardiología del deporte.
- Fisiología del esfuerzo.
- Nutrición y ayudas ergogénicas.
- Cineantropometría.
- Lesiones deportivas: diagnóstico, prevención y tratamiento.
- Actividad física y salud.

Las Comunicaciones Orales se distribuirán en sesiones de los temas del Congreso. Por favor, escoja uno de los temas del listado como propuesta para realizar su presentación. El Comité Científico podrá reasignar el abstract en otro tema del Congreso.

Los trabajos deberán ser originales y no se habrán presentado en congresos anteriores o reuniones similares.

Las comunicaciones científicas admitidas, comunicaciones orales y pósters (presentación interactiva), serán publicadas en la revista Archivos de Medicina del Deporte.

Normas de remisión de abstracts

Por favor, preste atención a las siguientes normas de preparación del abstract de su comunicación científica (comunicación oral o póster: presentación interactiva), porque son de obligado cumplimiento:

- La fecha límite para la remisión de los trabajos científicos será el día **14 de septiembre de 2018**.
- Se remitirá la Comunicación Científica a la atención del presidente del Comité Científico, con el formulario debidamente cumplimentado, a la siguiente dirección de correo electrónico: **congresos@femede.es**.
- El abstract tiene que tener una clara relación con los contenidos del XVII Congreso Nacional de la Sociedad Española de Medicina del Deporte y, en definitiva, con la Medicina y Ciencias del Deporte.
- El Comité Científico podrá destinar el trabajo presentado a la forma de presentación (comunicación oral o póster: presentación interactiva) que considere más adecuada al tipo y contenido del mismo.
- El Comité Científico se reserva el derecho de rechazar los trabajos que no cumplan los requisitos indicados anteriormente por la calidad y temática que el evento científico requiere.

Forma de preparación del abstract

- Sólo se aceptarán las comunicaciones científicas presentadas en el formato electrónico que se encuentra en la página web del Congreso: http://www.femede.es/congresotoledo2018/ "Formato de comunicación científica".
- **Título:** El título deberá ser breve (máximo de 15 palabras) y específico. Debe reflejar el contenido de la presentación. No use abreviaturas en el título. Se escribirá en letras mayúsculas, usando el tamaño 12 del tipo de letra Arial.
- **Autores:** Se escribirá, en minúsculas, el apellido seguido, sin coma, de la inicial del nombre de cada autor, separados por comas.
- **Centro:** Indicar el centro de trabajo de los autores. Si son varios, indicar con un número superíndice.
- **Preferencia de presentación:** Seleccionar con un asterisco el tipo de presentación a la presenta la comunicación científica.
- **Texto:** La extensión máxima del texto es de 300 palabras o 3.000 caracteres. Se escribirá en minúsculas,

usando el tamaño 10 de la letra Arial. Se evitarán abreviaturas no explicadas. Se escribirá el contenido del resumen científico sin repetir el título de la Comunicación y ajustándose al siguiente esquema: introducción, material y métodos, resultados y conclusiones.

- Respetando la extensión máxima del texto se pueden incluir tablas, gráficos o imágenes.
- Es obligatorio indicar un máximo de **tres palabras clave**.
- Los abstracts deben incluir **información específica** sobre los resultados y las conclusiones de la investigación. No se aceptarán abstracts que establezcan que "se discutirán los resultados".

Notificación de la recepción de la comunicación científica

En el plazo de 15 días, Vd. recibirá la confirmación de recepción de la comunicación por parte de la Secretaría del Congreso. Si no la recibiera, no vuelva a remitir la comunicación y envíe un mensaje electrónico: congresos@femede.es.

Inscripción del responsable de la comunicación científica

- Cada persona puede presentar dos comunicaciones científicas como máximo (comunicación oral o póster: presentación interactiva). En caso de ser aceptadas ambas, sólo una de ellas podrá ser presentada como comunicación oral.
- Los autores (CADA UNO PUEDE PRESENTAR DOS TRABAJOS) que presenten una comunicación científica (comunicación oral o póster-presentación interactiva) y ésta haya sido aceptada, deben haberse registrado y **haber pagado los derechos de inscripción del Congreso antes del 25 de octubre de 2018**. En caso contrario su comunicación científica (comunicación oral o póster-presentación interactiva) será eliminada del programa y del libro de abstracts.
- Cada autor puede FIRMAR todos los trabajos que quiera.
- No hay limitación en el número de comunicaciones que puede aparecer una misma persona.

Presentación de la comunicación oral

- Las Comunicaciones Orales tendrán un **tiempo de presentación de 8 minutos.** Al final de cada sesión habrá un turno de preguntas.
- Todas las exposiciones orales se harán en **formato Powerpoint**, debiendo estar en posesión del responsable de las Comunicaciones de la organización el día anterior a la presentación de la misma.
- Se limita a un **máximo de 12 el número de diapositivas** de la presentación de powerpoint.

Póster (presentación interactiva)

Si su abstract se acepta, pero no se puede ajustar a una presentación en forma de Comunicación Oral, se le propondrá presentarlo en forma de póster-presentación interactiva, dándole un tiempo para su preparación.

Presentación del póster (presentación interactiva)

Para la elaboración del póster (presentación interactiva) debe seguir las siguientes instrucciones que son de obligado cumplimiento:

- Formato **Microsoft Powerpoint**.
- Hasta 12 diapositivas, de las cuales:
  - La primera: debe contener **título, autores, centro de trabajo**.
  - La última: debe contener **título** y la palabra **FIN** o expresión similar que indique que la presentación ha concluido.
  - La penúltima o las dos penúltimas deben contener las **conclusiones**.
- Fondo de diapositivas: color neutro y uniforme.
- Texto de diapositivas: color que **contraste** con el fondo.

- En lo posible evitar incluir vídeos en las diapositivas, si se hiciera debería ser en formato **.wmv** y se deberá incluir en un subdirectorio/carpeta que enlace automáticamente con la presentación remitida. Si el video no enlazara con la presentación, no se editará por parte de la organización para corregir el error.
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- Se cuidará de igual manera de incluir las referencias bibliográficas oportunas en pequeño tamaño de letra, pero que sea legible.
- El abstract debe remitirse preparado tal como se indica anteriormente **(Forma de preparación del abstract)**.
- Una vez que se le confirme que su comunicación científica ha sido aceptada para ser presentada en forma de póster (presentación interactiva) debe enviar el documento electrónico **(.Ppt)**:
  - Trabajos destinados por el autor directamente a póster (presentación interactiva): **antes del 14 de septiembre de 2018**.
  - Trabajos destinados por el autor a Comunicación Oral y que el Comité Científico destina a póster (presentación interactiva): **antes del 20 de septiembre de 2018**.
- El documento electrónico **(.Ppt)**: debe enviarse a la dirección electrónica del Congreso: congresos@femede.es.

Certificaciones

Tras la presentación de la comunicación oral o la defensa del póster en el modo en que se indique se entregará un **único certificado** al responsable de la comunicación científica.

Publicación de los trabajos científicos

Los abstracts de los trabajos científicos (comunicaciones orales y póster) **aceptados y presentados** en el XVII Congreso Nacional de la Sociedad Española de Medicina del Deporte serán publicados en la revista ***Archivos de Medicina del Deporte***, publicación científica de esta especialidad y revista oficial de la Sociedad Española de Medicina del Deporte, que tiene una periodicidad de publicación bi-mensual.

Los inscritos en el Congreso que presenten comunicaciones podrán optar al Premio a la **Mejor Comunicación oral** del Congreso.

Para optar al premio **SE DEBE HACER CONSTAR EXPLÍCITAMENTE QUE SE OPTA A PREMIO** en carta dirigida al presidente del Comité Científico y adjuntar al Resumen remitido. En este caso, además de enviar el Formato del Resumen de Comunicación Científica, se debe de mandar el trabajo completo en el plazo de presentación de las Comunicaciones Científicas, presentado según las normas de publicación de la revista Archivos de Medicina del Deporte.

Los trabajos que se presentan en formato de póster (presentación interactiva) no optan a premio.

El trabajo que obtenga la segunda mejor puntuación, y supere en nivel de calidad exigible, será dotado con un accésit a la Mejor Comunicación del Congreso.

Dotación de los premios

Premio a la Mejor Comunicación Oral del Congreso:

- Dotación económica: 1.500 euros.
- Certificado acreditativo.
- Publicación en la revista Archivos de Medicina del Deporte con indicación del premio obtenido.

Accésit a la Mejor Comunicación Oral del Congreso:

- Dotación económica: 1.000 euros.
- Certificado acreditativo.
- Publicación en la revista Archivos de Medicina del Deporte con indicación del premio obtenido.

Los trabajos premiados serán publicados en la revista Archivos de Medicina del Deporte y se aceptará la revisión efectuada por el Comité Científico.

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29-30 de noviembre y 1 de diciembre de 2018

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Idioma oficial

El lenguaje oficial del Congreso es el español.
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	Antes del 31/8/2018	Del 1/8/2018 al 8/11/2018	Desde el 9/11/2018 y en Congreso
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2018		
14º Congreso Internacional de European Congress of Adapted Physical Activity (EUCAPA)	3-5 Julio Worcester (Reino Unido)	Andrea Faull. E-mail: a.faull@worc.ac.uk Ken Black. E-mail: k.black@worc.ac.uk
23rd Annual Congress of the European College of Sport Science	4-7 Julio Dublín (Irlanda)	web: www.ecss-congress.eu/2018/
World Congress of Biomechanics	8-12 Julio Dublín (Irlanda)	web: http://wcb2018.com/
12th World Congress of the International Society of Physical and Rehabilitation Medicine (ISPRM)	8-12 Julio París (Francia)	web: http://isprm2018.com/
21st World Congress on Nutrition & Food Sciences	9-10 Julio Sydney (Australia)	web: https://nutritioncongress.nutritionalconference.com
International conference on adaptations and nutrition in sports	18-20 Julio Bangsaen, Chonburi (Tailandia)	web: https://conference.kku.ac.th/icans/
The Annual World Congress of Orthopaedics	25-27 Julio Milán (Italia)	web: http://www.bitcongress.com/wcort2018 / http://www.bitcongress.com/wcort2018/programlayout.asp
World Congress of the Association Internationale des Ecoles Supérieures d'Education Physique (AIESEP)	25-28 Julio Edimburgo (Reino Unido)	web: http://aiesep.org/
63º Congreso Sociedad Chilena de Medicina del Deporte	23-25 Agosto Huechuraba (Chile)	web: http://sochmedep.cl/
XXXV Congreso Mundial de Medicina del Deporte	12-15 Septiembre Rio de Janeiro (Brasil)	web: www.fims.org
28º Congress European Society for surgery of the shoulder and the elbow (SECEC-ESSSE)	19-22 Septiembre Ginebra (Suiza)	web: www.secec.org
XI Congress Société Française de Médecine de l'Exercice et du Sport (SFMES)	20-22 Septiembre Le Havre (Francia)	web: www.sfmes.org
10th edition of the IOC Advanced Team Physician Course	25-27 Septiembre Marrakech (Marruecos)	web: www.ioc-preventionconference.org/atpc2018/
55 Congreso SECOT	26-28 Septiembre Valladolid	web: www.secot.es
5th International Scientific Tendinopathy Symposium (ISTS)	27-29 Septiembre Groningen (Países Bajos)	web: http://ists2018.com/
EFAD (European Federation of the Associations of Dietitians) Conference	28-29 Septiembre Rotterdam (Países Bajos)	web: http://efadconference.com/
VII Congreso Iberoamericano de Psicología del Deporte	3-5 Octubre Las Condes (Chile)	web: www.postgradounab.cl/actividades/vii-congreso-iberoamericano-de-psicologia-del-deporte/
XXVIII Congreso AMLAR 2018 - Asociación Medica Latinoamericana de Rehabilitación	3-6 Octubre Guayaquil (Ecuador)	web: http://amlar2018.com/

49 Congreso Nacional de Podología	5-6 Octubre Santiago de Compostela	E-mail: comiteorganizador@49congresopodologia.com E-mail: podologia2018@compostelacongresos.com
II Congreso de Alimentación, Nutrición y Dietética	5-6 Octubre Madrid	web: http://www.congresoand.com/2018/
Congreso Internacional Cubamotricidad 2018	22-26 Octubre La Habana (Cuba)	web: http://cubamotricidad.inder.gob.cu
VII Congreso Internacional de Entrenadores de Piragüismo de Aguas Tranquilas y I Congreso Internacional de Slalom	26-28 Octubre Catoira (Pontevedra)	web: www.congresocatoira.es
VII Congreso Asociación Hispanoamericana de Médicos del Fútbol	3-4 Noviembre Lima (Perú)	web: http://hispamef.com/
2as Jornadas Nacionales SETRADE	8-9 Noviembre Vitoria	web: www.setrade.org
7º Congreso Mundial del Deporte Escolar, Educación Física y Psicomotricidad	8-10 Noviembre A Coruña	web: www.sportis.es/congresos
XVIII Congreso latinoamericano de Nutrición (SLAN) 2018	11-15 Noviembre Guadalajara (México)	web: www.slaninternacional.org
X Congreso de la Asociación Española de Ciencias del Deporte	21-23 Noviembre La Coruña	web: www.aecdcoruna2018.com
XII World Congress on Mountain Medicine	21-24 Noviembre Kathmandu (Nepal)	web: http://ismm2018.org/
XVII Congreso Nacional de la SEMED-FEMEDE	29 Noviembre-1 Diciembre Toledo	web: www.femede.es
2nd International Conference on Sports Medicine & Sports Sciences	5-7 Diciembre Nueva Delhi (India)	E-mail: saicon2delhi2018@gmail.com
2019		
BKAM 2019: Barcelona associated Knee Meeting	6-9 Febrero Barcelona	web: www.bkam.info
XVI Congreso Nacional de Psicología de la Act. Física y del Deporte	13-16 Marzo Zaragoza	web: www.psicologiadeporte.org
XXXVI Congresso FMSI: "Età biologica, età anagrafica"	27-29 Marzo Roma (Italia)	web: www.fmsi.it/
2019 AMSSM Annual Meeting	12-17 Abril Houston (EEUU)	web: https://www.amssm.org/
12th Biennial ISAKOS	12-16 Mayo Cancún (México)	web: www.isakos.com
VIII Congreso Iberoamericano de Nutrición	3-5 Julio Pamplona	web: http://www.academianutricionydietetica.org/congreso.php?id=7#
24th Annual Congress of the European College of Sport Science	3-6 Julio Praga (Rep. Checa)	E-mail: office@sport-science.org

13th Congreso Mundial de la International Society of Physical and Rehabilitation Medicine	9-13 Julio Kobe (Japón)	web: http://www.isprm.org
14th International Congress of shoulder and elbow surgery (ICSES)	17-20 Septiembre Buenos Aires (Argentina)	web: www.icses2019.org
5th World Conference on Doping in Sport	5-7 Noviembre Katowice (Polonia)	web: http://www.wada-ama.org/
2020		
IOC World Conference Prevention of Injury & Illness in Sport	12-14 Marzo Mónaco (Principado de Mónaco)	web: http://ioc-preventionconference.org/
25th Annual Congress of the European College of Sport Science	1-4 Julio Sevilla	E-mail: office@sport-science.org
International Congress of Dietetics	15-18 Septiembre Cape Town (Sudáfrica)	web: http://www.icda2020.com/
XXXVI Congreso Mundial de Medicina del Deporte	24-27 Septiembre Atenas (Grecia)	web: www.globalevents.gr
2021		
26th Annual Congress of the European College of Sport Science	7-10 Julio Glasgow (Reino Unido)	E-mail: office@sport-science.org
22nd International Congress of Nutrition (ICN)	14-19 Septiembre Tokyo (Japón)	web: http://icn2021.org/
European Federation of Sports Medicine Associations (EFSMA) Conference 2021	28-30 Octubre Budapest (Hungría)	web: http://efsma.eu/

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Curso "ENTRENAMIENTO, RENDIMIENTO, PREVENCIÓN Y PATOLOGÍA DEL CICLISMO"

Curso dirigido a los titulados de las diferentes profesiones sanitarias y a los titulados en ciencias de la actividad física y el deporte, destinado al conocimiento de las prestaciones y rendimiento del deportista, para que cumpla con sus expectativas competitivas y de prolongación de su práctica deportiva, y para que la práctica deportiva minimice las consecuencias que puede tener para su salud, tanto desde el punto de vista médico como lesional.

Curso "ELECTROCARDIOGRAFÍA PARA MEDICINA DEL DEPORTE"

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (ON-LINE 1/5/2018 A 1/5/2019) CON 4,81 CRÉDITOS

Curso dirigido a médicos destinado a proporcionar los conocimientos específicos para el estudio del sistema cardiocirculatorio desde el punto de vista del electrocardiograma (ECG).

Curso "FISIOLOGÍA Y VALORACIÓN FUNCIONAL EN EL CICLISMO"

Curso dirigido a los titulados de las diferentes profesiones sanitarias y a los titulados en ciencias de la actividad física y el deporte, destinado al conocimiento profundo de los aspectos fisiológicos y de valoración funcional del ciclismo.

Curso "AYUDAS ERGOGÉNICAS"

Curso abierto a todos los interesados en el tema que quieren conocer las ayudas ergogénicas y su utilización en el deporte.

Curso "CARDIOLOGÍA DEL DEPORTE"

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (ON-LINE 1/5/2018 A 1/5/2019) CON 8,78 CRÉDITOS

Curso dirigido a médicos destinado a proporcionar los conocimientos específicos para el estudio del sistema cardiocirculatorio desde el punto de vista de la actividad física y deportiva, para diagnosticar los problemas cardiovasculares que pueden afectar al deportista, conocer la aptitud cardiológica para la práctica deportiva, realizar la prescripción de ejercicio y conocer y diagnosticar las enfermedades cardiovasculares susceptibles de provocar la muerte súbita del deportista y prevenir su aparición.

Curso "ALIMENTACIÓN, NUTRICIÓN E HIDRATACIÓN EN EL DEPORTE"

Curso dirigido a médicos destinado a facilitar al médico relacionado con la actividad física y el deporte la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para prescribir una adecuada alimentación del deportista.

Curso "ALIMENTACIÓN Y NUTRICIÓN EN EL DEPORTE"

Curso dirigido a los titulados de las diferentes profesiones sanitarias (existe un curso específico para médicos) y para los titulados en ciencias de la actividad física y el deporte, dirigido a facilitar a los profesionales relacionados con la actividad física y el deporte la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para conocer la adecuada alimentación del deportista.

Curso "ALIMENTACIÓN Y NUTRICIÓN EN EL DEPORTE" Para Diplomados y Graduados en Enfermería

ACREDITADO POR LA COMISIÓN DE FORMACIÓN CONTINUADA (NO PRESENCIAL 15/12/2015 A 15/12/2016) CON 10,18 CRÉDITOS

Curso dirigido a facilitar a los Diplomados y Graduados en Enfermería la formación precisa para conocer los elementos necesarios para la obtención de los elementos energéticos necesarios para el esfuerzo físico y para conocer la adecuada alimentación del deportista.

Curso "CINEANTROPOMETRÍA PARA SANITARIOS"

Curso dirigido a sanitarios destinado a adquirir los conocimientos necesarios para conocer los fundamentos de la cineantropometría (puntos anatómicos de referencia, material antropométrico, protocolo de medición, error de medición, composición corporal, somatotipo, proporcionalidad) y la relación entre la antropometría y el rendimiento deportivo.

Curso "CINEANTROPOMETRÍA"

Curso dirigido a todas aquellas personas interesadas en este campo en las Ciencias del Deporte y alumnos de último año de grado, destinado a adquirir los conocimientos necesarios para conocer los fundamentos de la cineantropometría (puntos anatómicos de referencia, material antropométrico, protocolo de medición, error de medición, composición corporal, somatotipo, proporcionalidad) y la relación entre la antropometría y el rendimiento deportivo.

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Guidelines of publication Archives of Sports Medicine

The ARCHIVES OF SPORTS MEDICINE Journal (Arch Med Deporte) with ISSN 0212-8799 it is the official publication of the Spanish Federation of Sports Medicine. It publishes original works on all of the aspects related to Medicine and Sports Sciences from 1984. It has been working uninterruptedly with a frequency of three months until 1995 and two months after then. It's a Journal that uses fundamentally the system of external review by two experts (peerreview). It includes regularly articles about clinical or basic investigation, reviews, articles or publishing commentaries, brief communications and letters to the publisher. The works may be published in SPANISH or in ENGLISH. The submission of papers in English will be particularly valued.

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Referencias bibliográficas:

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