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Introducción

Sport is a common phenomenon that has increased in importance at social level not only due to its media coverage but especially due to the number of practitioners of diverse sport activities and modalities.

The most important circumstance apart from the development of professional sport concerns the significant increase of recreational sport among amateur athletes as it is indicated in the last questionnaire about sport habits published in 2015. It is pointed out that the 53.5% of the 15-years-old or more population practiced sport, on regular basis or eventually[1], in the last year as it can be observed by the high participation rates registered in popular races in recent years.

There is no doubt about the beneficial effects of regular exercise and recreational sport in any of its disciplines on health[2-5], therefore, it is necessary to obtain a great degree of implication by the population in the practice of physical activity.

Recreational Sport is ludic and the enjoyable component of the practitioners plays an important role, involving also benefits for health.

Additionally, many recreational athletes have increased the time of practice looking for better and better performances. This fact has increased the risk of health problems and injuries[6-7].

Therefore, this document agreement aims to provide the recommendations of the better way of practicing recreational Sport for health and avoid the potential risks regarding physical activity.

Reasons to practice Sport

Probably, the main reason to begin a new recreational sport is precisely the ludic component that makes an activity pleasant and satisfactory.

The European Council defined sport in the European Sports Charter as Sport all forms of physical activity which, through casual or organized participation, aim at expressing or improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels[8].

Recreational Sport can be determined as any physical activity performed at free time, following the rules stablished by institutions or participants. Generally, the easy physical demands make the activity accessible by any person regardless of age and have a ludic component. Although, it is a physical activity aimed to improve quality life and social and family networks it has experienced a substantial increasing in competitiveness and performance requirements.

Other people consider sport to develop and maintain the functional capacity required to satisfy life-long demands and to promote a healthy lifestyle. Therefore, it is necessary to have and maintain an adequate physical fitness level[9].

Since the recreational athlete directs sport to the enjoyment of the activity, the achievement of competitive results should be considered in second place, which in the motivational theory of the goals is called task-oriented sport practice[10-11].

Although the competition is not necessarily an inconvenience, and in fact many aspects of life are understood in a competitive sense, this one has several risks as a consequence competition characteristics that make athletes perform beyond its possibilities, in addition to those that are derived from the possibility of having some disease and injuries. Therefore, competition must be understood with sensibly[12].

The last study published by the Ministry of Education, Culture and Sport[1] on sports habits of Spanish population older than 15 years indicates that 19.5% of the population practice sports on daily basis, 46.2% at least once per Week, 51% of the population practice at least once a month and 52.3% at least once per Trimester.

On average, those who practiced sport on a weekly basis dedicated 312.1 minutes a week to their sporting activity, which is within the global recommendations on physical activity for health given by the World Health Organization[13] for ages ranged between 18 and 64 years, stablished at a minimum of 150 minutes per week to 300 to obtain greater health benefits.

The reasons for sports practice in Spain[1] are to be fit (29.9%), fun or entertainment (23%), health reasons (14.8%), leisure (13.7%), pleasure for sport (11.9%), as a form of social networking (2.6%), personal improvement (1.8%), and in some cases by profession, while the reasons for not playing sports are lack of time (43 , 8%), lack of interest (20%), health (11.9%), age (9.9%), economic reasons (5.7%), lack of adequate facilities nearby , 1%) and in some cases lack of company.

Beneficial effects of Sport on Health

The continuous and daily practice of physical activity and sport is paramount in any healthy lifestyle. Numerous experiences and scientific evidence support the fact that exercise is beneficial for people of all ages and both sexes, including people with some chronic diseases, providing a wide range of physical, psychological and social benefits to health[9,14-17]. Supported by this background and in the existing evidence[18] there is a unanimous opinion among medical professionals that entertaining sport is beneficial, highly recommended and essential to preserve and improve the health of the population[19,20]. No other therapeutic strategy, even the pharmacological and nutritional ones, obtains so many healthy effects, in number and duration, on the organism.

Among the previously ratified and widely accepted benefits[21], a number of very positive effects on health, such as the prevention and control of overweight and obesity, insulin resistance syndrome and diabetes Mellitus type 2, of total cholesterol levels with an increase in the beneficial HDL-cholesterol to health and of the triglycerides.

Already in the 80's of the last century, a series of extensive and endorsed studies provided strong evidence of the great relationship between the practice of physical activity and the reduction of mor-

tality by cardiovascular causes. The Multiple Risk Factor Intervention Trial[22] and the Framingham Heart Study[23] are good examples.

Sedentary lifestyle has become an important risk factor and a public health problem as expressed by the World Health Organization (WHO) in its 2002 report[24], and therefore, sport is fundamental in cardiovascular prevention[25].

From the multiple evidences of the beneficial effects of the physical and sports activity on the cardiovascular apparatus a great amount of conclusive studies on the effects of the exercise on the prevention and on the treatment of multiple chronic diseases and also on others Areas have been included.

Sport has beneficial effects at organic, psychological and even social level.

Table 1 summarizes the main beneficial effects of physical activity on the organism[24,26-40].

Table 2 summarizes the main beneficial effects of physical exercise at the psychological level[41-46].

Physical exercise also has significant beneficial effects at the social level as it is described in Table 3[847-49].

Table 1. Organical benefits.

System	Effect
Cardiovascular	– Cardiac capacity improvement – Cardiac perfusion increase – Bradycardia effect – Higher oxygen supply – Lower oxygen demand – Lower catecholamine concentration – Benefits on blood pressure – Heart disease prevention on adult age
Metabolism	– Lower LDL concentrations – Higher HDL concentrations – Weight reduction – Adipose tissue redistribution – Greater tolerance to glucose – Decrease on insulin production – Increase of tissue sensibility to insulin – Improvements on muscle's energy transformation mechanisms
Respiratory	– Respiratory muscles strengthening – Respiratory capacity improvement – Lung perfusion increase – Expectorant effect
Musculoskeletal system	– Higher bone mass – Higher articular stability – Better movement development in children and teenagers – Growth stimulation – Higher muscular strength – Higher flexibility – Less osteoporosis risk – Osteoarthritis compensation – Decreases on falling risks
Immunological system	– Higher infection tolerance – Neoplasms prevention (colon, colorectal, mammary gland on post-menopausal women, endometrium, esophagus and kidney)
Other	– Increase of cerebral flow – Increase of aerobic endurance – Increase of pain threshold – Pleasure – Less tobacco use – Death risk reduction

Sport Practice Risks

Nowadays, no one questions that healthy physical exercise increases physical, psychological and social well-being is an essential element in health promotion and is suitable for all types of people, regardless of age, sex or health status[37,50]. However, sport is also associated with certain health risks.

There are no conclusive studies that show that high-intensity sport is beneficial whereas there is some evidence to suggest that it can be dangerous. It is said that strenuous exercises or those that exceed physical capacity can have contrary results to what is expected, especially if the technique of execution is inappropriate.

It is important to differentiate between the risks of sport in healthy individuals (which are minimal) and those that exist in people with previous illnesses or injuries. Even recreational sports may have risks that should be taken into consideration for prevention.

Cardiovascular Risks

Athletes who train at high intensity can develop changes in the heart (which increase the risk of arrhythmias and other cardiac pathologies), and when they perform strenuous physical exercise the risk of coronary ischemia, acute myocardial infarction and sudden death[32,51,52] temporarily increased. Nevertheless, there is no clear definition of what intense exercise is, so it is difficult to recognize athletes with high risk. On the other hand, it must be taken into account that the balance between damages and benefits is clearly favorable to them. In general, risks will depend largely on the state of health or illness of people who practice sport.

Although there are many publications on myocardial adaptations to exercise in high-level athletes, there is little data on the effect of recreational training and changes on cardiac function. In a study of middle-aged men, lond-distance training (marathon) is associated with biventricular dilatation, increased left ventricular diastolic function, and decreased cardiovascular risk, so it can be an effective strategy to decrease the incidence of cardiovascular diseases[52].

The risk of sudden death, coronary ischemia or other cardiovascular pathologies is very low with moderate physical exercise[53], but it

Table 2. Psychological benefits.

– Less susceptibility to stress
– Lower neurosis risk
– Higher self-esteem
– Sports motivation
– Increase of self-confidence
– Reduction of cardiovascular responses to stress
– Better psychological adjustment
– Greater cognitive function
– Lower levels of anxiety and depression
– Lower depression risks
– Delay and even improvements of some neuropsychiatric diseases such as dementia

Table 3. Social benefits.

– Social integration
– Better academic results
– Communication/relation with partners
– More discipline
– Team work
– Decrease of violence aggressions
– Distancing from damaging environments: alcohol, tobacco, drugs, juvenile delinquency

increases with high intensity activity, especially in sedentary people who begin to practice sports or in those who occasionally practice sports and with heart congenital diseases or other cardiovascular risk factors.

Risks for the musculoskeletal system

The practice of sport always carries some risk of suffering an injury or accident. Although no significant differences have been observed, physically active people tend to suffer a greater percentage of injuries (muscle injuries, sprains, tendinopathies, etc.) than sedentary ones[54,55]. Most of them are due to a lack of preventive measures with different factors affecting such as age, type of activity, amount and intensity of exercise, previous injuries, fatigue, body mass index and other circumstances[56,57].

A recent meta-analysis has shown that the rate of injuries in recreational runners is 7.5 injuries per 1,000 hours of exposure, much lower than that observed in inexperienced runners, which is 17.8 injuries[58].

Within the multiple causes of injuries in recreational sports practitioners are bad equipment (mainly footwear) or lack of protective measures in some sports. Thus, safety helmets clearly reduce the risk and severity of head injuries in cycling, skiing and snowboarding[59].

During childhood and youth, recreational sport involves few health risks, although there are some age-related overload injuries such as Osgood Schlatter, Sinding-Larsen or Sever disease. Also in this period accidents in team sports, cycling, skating or skiing are more frequent, but they do not usually involve important consequences[60]. When you practice high level sport of competition at these ages all these problems are aggravated and multiplied.

Among the troubles that sport might produce, especially in high-intensity sports, it can be observed an increased joint wear, basically intervertebral discs, hips, knees and ankles. Thus, there appears to be an increased risk of osteoarthritis in high-impact sports practitioners[32,61].

In those people with musculoskeletal system diseases, recreational sports are recommended, but depending on the pathology and degree of illness some exercises might have negative consequences. When there is joint pain and swelling, activities involving overload are considered an added risk.

In patients with osteoporosis, the risk of fractures is higher, therefore, all preventive activities should be carried out in order to strengthen postural muscles and improve balance. In addition, since body weight favors instability it is necessary to avoid being overweight as well as sudden and extreme movements of the trunk[62].

Extreme temperatures

Physical exercise in certain environments, and especially in children and the elderly, may add an extra risk to health. Thus, the practice of physical activity in extreme temperatures is an important risk factor. Special care should be taken in those who are under diuretics (increased risk of dehydration), beta-blockers, and some other medical treatment.

Water activities

They have their own risks, especially when practiced in contaminated waters where skin infections or gastroenteritis can occur. Additionally, there are more serious risks when practicing swimming in dangerous areas and scuba diving that can lead to different diseases among which the most common is otitis[63]. Do not forget the risk of drowning, hydrocution and hypothermia.

Furthermore, some relatively new, funny, adventure, risk or "extreme" sports, which are characterized by the risk of suffering any type of injury or accident must be taken into consideration.

Post-exercise rhabdomyolysis

Another risk of sport practice is rhabdomyolysis, characterized by the destruction of the muscle fibers after intense physical exertion (with plasma releasing of the cellular content) that produces myalgia, weakness and choluria. Although rare, it can occur in people who perform a much more intense activity than they are used to, mainly eccentric exercises. Recently, the use of electrostimulation devices to

generate isometric muscular contractions has been associated with rhabdomyolysis. This may have dangerous consequences such as increased CK, myoglobinuria, acute renal failure, arrhythmias, etc.[62,64].

Muscle Dysmorphia

Another problem that ends up affecting health concerns exercise addiction (muscular dysmorphia or vigorexia) that is observed in some recreational sports practitioners who look for permanent performance increases and excessive interest to gain. These addict people primary focus on sport before any other activity. They constantly seek perfection and their life revolves around the sport that is no longer a reason for fun[65]. They may even use dopant substances to increase performance, with consequent negative effects.

Risk in pregnancy and postpartum

Active or inactive pregnant women, provided there are no specific contraindications, may and should perform physical activity and preparation exercises for childbirth and postpartum, almost without restrictions. A recent meta-analysis describes a case of fetal bradycardia or tachycardia, fetal ischemia during exercise, fetal hyperthermia, fetal hypoglycemia (13 cases / 49,000 hours of exercise), possibly due to intensity or some postures. The risk for the mother is also very low (around 1.4 cases per 10,000 hours of exercise); most of the problems are minor problems. Heavy exercise can increase back pain[66].

On the other hand, it is also worth bearing in mind that during pregnancy there is an increased ligament laxity so that this can increase the risk of sprains and other soft tissue injuries.

Risks in diabetics

Physical activity leads to a decrease in glycemia in patients with type II diabetes and an increase in insulin sensitivity lasting 12-72 hours. Thus, regular practice of physical exercise improves the disease and its side effects. However, when basal glycemia is elevated (hyperglycemia above 300 mg / dl with ketone), sport should not be practiced until levels decrease due to its major risk factor nature. Performing physical activity with hypoglycemia (<70 mg / dl) is not recommended either.

To avoid health problems, it is essential to practice sports with controlled glycemia, to carry fast-acting carbohydrates and to always carry an identification of the disease in case an incident occurs[67].

In addition, diabetics must have special care in the feet, especially if they have peripheral neuropathy with loss of sensitivity because it implies an increased risk of ulcers or injuries. In patients with diabetic retinopathy, intense activity may involve vitreous hemorrhage or retinal detachment.

Risks in respiratory patients

The risk of having an asthma attack increases when performing high-intensity sport with low fitness level, in cold and dry environments, when air is contaminated or when there are respiratory tract infections. Risk sports such as diving, speleology or climbing should be avoided and when practicing sport, emergency medication must always be available[68,69].

Risks in hypertensive patients

Hypertensive individuals, before performing intense physical activity, have to normalize their blood pressure since otherwise the risk of suffering cardiovascular disease increased[16,17].

In conclusion, the regular practice of moderate physical exercise is beneficial to health and therefore recommended and intense training is also beneficial, but involves risks (sudden death, among others) in some people depending on the level of health and type of activity.

The choice of sport

There are many determinants that lead a person to choose a sport and, very rarely, the recreational athletes considers to look for advice and information about the sport that may be more beneficial and healthy. Quite the contrary, the athlete chooses his sport, obtains the necessary elements for his practice and undertakes a career that very often leads him to excessive time expenditure of training looking for high levels of performance.

Nowadays, popular practitioners have abruptly increased in number interested by amateur races, including cycling and walking, running, in its various forms (10 km. medias, marathons, ultramarathons and other extreme careers) that congregate hundreds of thousands of participants. Frequently, these athletes struggle to achieve high performance levels, to improve personal times and to carry out difficult tests that, in many cases, are not even performed by elite athletes.

With no doubts, the practice of physical activity including any sport is very beneficial and desirable, and the efforts of international organizations to promote physical activity by the majority of the population are increasingly important[13,70]. In addition, some medical societies recommend physical activity for maintenance and improvement of health to all kind of people population, including people with chronic diseases[9,32,71].

However, it is known that sports, including recreational sports, may have undesirable effects[72-74]. Therefore, it would be highly desirable that at least adult and older athletes who start in sports practice, those who rejoin it after a long time without practicing it and those who have some type of pathology or several risks factors (Table 4), ask the specialist in Sports Medicine about the best suitable sport to their particular situation and the proper and convenient way to practice it.

The choice of sport is a great importance aspect because the achievement of the goals that are marked by the athlete and the maintenance of the activity on regular basis and throughout his life

Table 4. Cardiovascular risk factors[75].

Subclinical disease
– Carotid IMT
– Coronary calciu
– Endothelial dysfunction
– Other…
Biochemical/physiological markers
– High LDL concentrations
– Low HDL concentrations
– High triglyceride concentrations
– High blood pressure
– Hyperglycemia/diabetes
– Obesity
– New markers (CRP…)
Environmental factors/Way of life
– Tobacco
– Sedentary lifestyle
– Diet/alcohol
– Atmospheric pollution
Genetics
– Genetic markers
– Familiar cardiovascular disease records

IMT: intima-media thickness. CRP: C-reactive protein.

Table 5. Determining factor for sports choose.

– Pathology presence
– Previous experience
– Athlete goals
– Personal preferences
– Resources available

will depend on the sport choice. The aspects that should determine the choice of the sport are listed in Table 5.

Presence of pathology

The increase of the age of the athlete is associated with pathologies that can condition his sport practice. It is not the purpose of this document to describe in detail the diseases or alterations that influence sport practice. Only a few observations will be taken into account when an athlete considers the sport selection. These pathological circumstances should not be confused with contraindications to sports practice[76] because their meaning and transcendence are different. Contraindication implies the impossibility of practicing sport, whereas these recommendations mean that, not constituting a formal contraindication, their presence may cause in the athlete inconveniences, discomforts or risks that he should know and decide accordingly.

The following are some situations to consider when making a recommendation on the choice of sport[77].

Orthopedic alterations. Scoliosis and hyperkyphosis can be affected by sports that use heavy loads of weight (weightlifting, bodybuilding techniques, bodybuilding). Discal injuries are aggravated by sports involving vibrations (motorcycling, mountain biking), spinal hyperextension (butterfly and breaststroke swimming styles, gymnastics) and torso twisting.

Pathological flat feet, some injuries of the hip and knee can be affected in standing sports with heavy loads.

Supraspinatus tendon injuries and shoulder calcifications are affected by swimming and throwing.

Overweight / Obesity. Excessive weight can be poorly tolerated in athletic sports.

Cardiovascular disorders. In general, each situation has to be individualized, but sports with high intensities and those involving excessive static work are not recommended. Lower limb varicose veins may be affected in standing sports and are at risk of hemorrhage and bruises.

Neurological pathologies. People with pathologies involving syncope, as well as epilepsy, are not recommended to practice sports in which the loss of consciousness, even if momentary, can have very serious consequences (diving, climbing, driving, even unsupervised swimming). Headaches / migraines can be aggravated in combat and contact sports.

Visual acuity alterations. They imply a limitation in precision sports and driving.

Counterproductive effects of some medications. Some circumstances are mentioned, such as the risks involved in the use of depressant medication of the central nervous system in sports in high-risk environments (mountain, diving, driving sports), the limitation of heart rate increases in endurance sports due to the use of beta-blockers, or the risks of dehydration in long-term sports in a hot environment with the use of diuretics.

Urological alterations. Sports in which you are sitting on narrow supports, such as cycling, rowing or canoeing, may be less advisable in practitioners with prostate pathologies.

Other situations. Outdoor sports are not recommended in people with environmental allergies; Swimming and water sports for cutaneous hypersensitivity to chlorine, recurrent otitis media and tympanic alterations; Sports resistance for iron-deficiency anemia.

It is dangerous to practice combat sports and contact sports in the presence of breast lumps; Sports with a high static component in abdominal hernias; Sports of resistance and those that involve situations of fear (white canoeing) with irritable colon; And combat and contact sports when carrying orthodontics.

Previous sports experience

The re-start of sports practice occurs mainly in two ways: after an injury or illness with a long recovery process, or after the retirement at young ages and returning many years later.

The reincorporation to sports after an injury, although it may mean a long period, does not usually involve other problems than those arising from the injury itself and its consequences. There are guidelines for re-entry into sport in the most appropriate way[78].

Two much more problematic situations are the return to the sport after a long abandonment and the beginning of the sport without previous experience in elderly people.

In the first case, it usually happens that the athlete has the memory of his youthful experience with his physical qualities intact and restarts his sport from this situation without being aware that he is many years older and has decreased his physical capacities and accumulating cardiovascular risk factor. Therefore, all these facts might involve situation of risk to health.

Older people tend to be more cautious and, since many of them start out in sport by medical advice or to improve their health[79] and they tend to have far fewer problems and engage in very healthy activities.

Goal of the athlete

The main reasons for practicing recreational sports are the maintenance of health and the physical condition development and the help for relaxation. Regarding the main objectives, the achievement of a personal reaffirmation, physical well-being, social and psychological well-being, and an optimal performance consecution might be observed[80].

Males are more motivated to engage in sports to excel in sports and achieve performance and personal reassurance than females, while older subjects are more motivated by socio-psychological well-being than younger subjects[80]. On the other hand, there is a negative correlation between age and number of sports chosen and a positive correlation between the age of athletes with the same affinities[81].

The analysis of motivations for sports participation by age groups[82] indicates that the motivations in adolescents and young women regard body shape, weight control, incorporation into new social networks, family support and social support.

In adults, the motivations are to achieve the sense of accomplishment, to develop physical abilities, to follow medical advice (which is very important numerically), to join social networks of support and for pleasure or enjoyment, while in elderly people, the motivations come from getting social support, achieving health benefits, taste for activity, improvement of physical condition and maintenance of joint mobility[79].

Individual preferences

The choice of sport, in any athlete but especially in the recreational ones, should be made according to the personal preference of each person. Even in situations that sport practice is a consequence of a medical prescription or the conviction of doing sport for health, the choice of the sport should be made based on the affinity of the person for the chosen sport.

Any sport that is performed without enthusiasm ends up being abandoned and, what is worse, would lead to a cessation of an active, fully recommendable way of life.

In the choice of sport or exercise, which is intended to have a high degree of adherence, the role of individual choice, preference and enjoyment is emphasized, especially because individuals may follow the recommendations for health improvement[32] in many ways[83].

Means availability

There are a number of circumstances that limit the choice of a sport[70].

- *Geographical limitations:* in general, it is a problem to choose a sport which requires moving long distances. For example, the practice of swimming or other water sports not having pool, river, swamp or coast close might be a problem. The same happens with the practice of skiing, ice skating or ice hockey with a lot of time of dedication, if there is not a winter season near the athlete's house.
- *Socio-economic constraints:* Economic availability can be an important constraint for many activities, which have relatively high costs allowing access only to middle and high income people.
- In fact, low economic availability is one of the causes of low participation in sports[84], having difficulties to afford the equipment and sports facilities. In this sense, a good sport recommendation to avoid this problem is the practice of running because of the low cost of the material and because sports facilities are not necessary.
- *Cultural limitations*: access to sports activities may also depend in part on awareness of the physical activity value for the person, both organically and psychologically.

Characteristics of Recreational Sports for Health

Many people set the goal sports practice to maintain or improve health[74], including the prevention or complementary treatment of various chronic diseases due to the obvious beneficial effects of physical exercise on health[85,86].

Any sport that is carried out in a sustained way in time is beneficial, but in an ideal way, the sports activity destined to health[74] should involve an energy expenditure of at least 1,000 kcal per week. This can be achieved with an appropriate combination of exercises aimed at improving cardiorespiratory and metabolic functioning (ie, aerobic training) and improving muscle function (low-force strength training), supplemented with functional and flexibility exercises[74].

They are sports that fulfill these characteristics such as the race on foot (jogging), the cycling, the Nordic march and the swimming. Since the objective is to maintain long-term activity, and because these activities are potentially more attractive and may contribute to join long-term-health-oriented exercise programs, it is possible to consider other sports such as Football[74].

Table 6. Sports classification depending on dynamic and static components in competition[88].

Static component	Dynamic component		
	Low (<40% O_2max)	**Moderate (40-70% O_2max)**	**High (>70% O_2max)**
High (>50% MVC)	Bobsleigh-Luge*†, Athletics Throwing, Gymnastics*†, Martial Arts*, Sailing, Climbing*†, Water Ski*†, Weightlifting*†, Windsurf*†	Bodybuilding*†, Alpine Skiing*†, Skate*†, Snowboarding*†, Fighting	Boxing*, Canoeing, Cycling*†, Decathlon, Rowing, Speed Skating, Triathlon*†
Moderate (20-50% MVC)	Archery, Motor Racing*†, Diving*†, Equestrian Sports*†, Motorcycling*†	American Football*, Athletics Jumps, Artistic Skating*, Rodeo*†, Rugby*, Athletics Speed Races, Surfing*†, Synchronized Swimming	Baloncesto*, Hockey hielo*, Esquí fondo *(skating), Lacrosse*,* Atletismo (medio fondo), Natación, Balonmano
High (< 20% MVC)	Pool, Bowling, Cricket, Curling, Golf	Baseball/Softball, Fencing, Table Tennis, Volleyball	Badminton, Nordic Skiing, Filed Hockey*, Orienteering, Race Walking, Racket sports/ Squash, Endurance Athletics, Football*, Tennis

CVM: Maximal voluntary contraction. *Collision risk. †Risks in case of syncope.

It has been seen that sports and physical activities such as running and tennis are associated with lower rates of obesity, smoking and alcohol consumption, compared to team sports. It seems that, among other reasons difficult to explain as the intensity of exercise, the most interesting is that, both running and tennis are integral components of healthy lifestyles, while team sports are part of forms of life risk[87].

The classic sports classification of Mitchell[88], which groups them according to the level of its dynamic and static components, provides the opportunity to recommend sports practice depending on the characteristics of the person, considering that the most beneficial for health are low-intensity sports with predominantly dynamic components (Table 6).

Medical revision before sports practice

Before beginning any sport, including recreational sports, a medical consultation should be carried out to diagnose the possible existence of diseases or alterations that may influence the athlete because of the effort made. This is especially important, considering that the recreational sport can have a high level of physical demand, moving away from some of its objectives such as improving the quality of life and health of its practitioners[12].

There are many scientific-medical organizations that recommend the performance of medical examinations for sports aptitude with the main objective of preventing sudden death of the athlete. One might find medical revisions from the simplest ones, advocated by the American societies and that do not require electrocardiogram (ECG)[89,90], to the most complete ones, such as that performed in Italy, which is mandatory and must be performed, in addition to ECG, exercise test and echocardiogram[91,92].

The European Society of Cardiology[93] and the Spanish societies of Cardiology[94,95] and of Sports Medicine[96] have proposed models of medical examinations for sports aptitude in different types of athletes.

In Europe, resting ECG practice is considered to be essential[76,93-98] and it is becoming more evident the need to perform stress tests not only for functional assessment, but also to rule out cardiovascular pathology in athletes, especially those over 35 years of age and with various pathologies[99].

In addition, revisions should be made to explore, not only the cardiovascular apparatus, but all those involved in sports activity[100] especially the musculoskeletal system[101] and body composition[102].

Frequently, recognition models, especially if they are intended for large population groups, are basic, with anamnesis, family and personal pathological antecedents, apparatus exploration, but including resting ECG, reserving other complementary diagnostic for cases in which the basic recognition finds suspicious symptoms of pathology[76,94-96].

Both medical examinations and exercise prescription, and the follow-up of the athlete, including the management of sports injuries should be performed by doctors with training and experience in sports. They are specialist in Physical Education and Sports Medicine the more suitable for the integral management of the athlete[12,103,104].

In the sports medicine clinic, a doctor / athlete relationship is established which the family and personal history are investigated, the athlete is explored to: a) evaluate the accommodation to physical exercise (flexibility, balance, reflexes, coordination of movements, body composition-cineanthropometry); b) to detect diseases with cardiovascular risk (sudden death of the athlete) or metabolic; c) to locate other problems (i.e. those derived from the sports gesture) and to evaluate pathologies or alterations already known and; d) to

allow, with the appropriate considerations, a safe and comfortable sport practice[12].

The sports doctor, after evaluating the data obtained according to age, type of sport, load and time of physical effort, will be able to establish the precise recommendations, to prescribe the patterns of the individualized exercise including the restrictions that can be given and to establish the appropriate periodicity for future consultations[12,24,29,30,32,37,76,90].

The direction of training and competition

One of the defining characteristics of sports activity is training. Sport training might be defined as the regular and scheduled procedures and actions destined to prepare or to train a person for the practice of sport.

Therefore, the training requires minimal knowledge of its form of execution.

Training is a process that has continuity over time, which is planned to achieve objectives and is done in a systematic way existing relationship between the parts of it. To be effective, it must follow the scientific principles of training theory, which is undoubtedly the goal for which you train, regardless of whether you are a professional or recreational sportsman, although the amateur athlete should not follow the training guidelines, preparation by professionals or performance athletes.

Therefore, if you want to carry a proper training program is necessary that it is designed, supervised and reviewed by appropriate professionals of the sport. Variables such as type of activity, preferences, age, sports history, injuries, goals, and available time should always be taken into account, among other factors, which will mark the type of goals to be achieved.

It is possible that the recreational sportsman of adult age, who performs his sport for recreational and recreational purposes and without pretensions of performance, is able to self-manage his preparation for sports practice. The training that has been received in Physical Education oriented to Health in its formative process[105,106], which has among its main objectives "to give the necessary knowledge to develop healthy habits of life where the sport is part of the occupation of free time of the person throughout his life" will allow it, especially if he has also played sports in his youth and knows the elementary training processes.

The problem arises when recreational athletes set themselves other goals, more typical of professional sport than recreational, applying training criteria that they could use in some previous sports activities[12], and, in addition, performing their activity without any advice, either intuitively or through what they can read in magazines, training books or the internet. This practice is not usually very useful to the athlete and is not without risks of all kinds, especially regarding health. The correct and advisable thing is that the program of training and the planning of the competitions is carried out by a qualified professional in the Sciences of the Physical Activity and the Sport. This ensures an adequate and healthy programming of the activity and an optimization of the limited time usually available to the recreational sportsman.

If there is something that defines the essence of the sport is the competition. The concept of sport is shaped in three pillars: the training, the rules of sports practice and, especially, the competition.

Competition is a critical moment. In competition, the athlete not only seeks maximum performance, but also experiences a series of organic responses that prepare the body for stress, such as nervous, metabolic responses such as catecholamine release and cardiovascular, with increased heart rate and blood pressure changes. All these responses, simultaneously to the psychological stress that accompanies a competitive situation, create an appropriate framework to increase the risk of sudden cardiac incidents and death[107-109].

All this justifies the importance of the athlete, in one way or another, to properly manage his training process.

Preparation for sport practice. The warm-up

The training session does not start with the chosen sport. A previous phase must be carried out which, although often not perceived as training, is an essential part of it and must be performed by all athletes. It is the warm-up "set of exercises, performed before an activity, that provide the body with a period of adjustment from rest to exercise. It aims to improve performance and reduce the possibility of injury through both mental and physical mobilization and activation"[110].

Warming is a period of preparation of the body so that physical exercise is performed in a more efficient way, characterized by an increase in body and muscle temperature and allowing an increase in the rate of metabolic reactions, an increase of mean nerve conduction and other effects not related to temperature increase such as baseline VO_2 elevation and post-activation potentiation. All this allows the athlete to achieve a higher performance[110], although this concept requires more detailed research for verification[111].

At the psychological level, warm-up boosts performance, assumes a mental rehearsal of sports gesture and technical situations before putting them into practice.

Although not all studies agree, the weight of evidence indicates that warming reduces the risk of injury[111].

Although forms of passive heating (hot showers, baths, saunas, diathermy or by the application of massage) have been described[112], the aim of raising muscle temperature is achieved only by active warming through exercise, although it may be supplemented by some passive techniques[113,114].

Static stretching has traditionally been recommended in the warm-up period[115] but there is conflicting literature regarding its usefulness in injury prevention and performance improvement.

Dynamic stretching is currently being recommended with throwing and bouncing movements without reaching extreme joint path positions of the main phase of training[110].

Given that there are no conclusive results[116-121], and until these could force to change a widely held custom, it seems appropriate to continue recommending the realization of short stretches.

The heating consists of two parts[114,122,123]:

- *General*. There are varied exercises not related to the sports modality. An "ideal" general warm-up should be intense enough to increase body temperature (between 40-70% VO2max), generate sweating, give the joint amplitude necessary to perform the technique and all this without getting to fatigue, preparing the body for optimal execution of the specific actions. The duration is 10-15 minutes.
- *Specific*. It is oriented to the sport in question and to the requirements of each sport discipline. The duration can vary from 10 to 15 minutes.

All warm-up programs must include stretching and the recovery period from the end of warm-up to the start of competition should not exceed 10 minutes[114].

In the execution of the heating, factors such as age, fitness level, time of day and especially environmental conditions should be taken into account. In addition, another important aspect is adequate hydration to begin training or competition under optimal conditions[124] and to avoid the risks of dehydration and heat on the body when exerting physical exertion[125].

The training

Training is understood as the preparation to perfect the development of an activity, especially for the practice of a sport, and involves a physical, technical and psychological preparation for the maximum development of the athlete's abilities[126].

In order to be considered as such, the training must be continuous, that is, it is repeated frequently, which produces a series of changes and transformations; Must be planned, that is, related to objectives; And must be systematic, ie structured as a system with interacting elements.

The main objective of the training is the improvement of performance, but in many cases the objectives are other, such as maintaining a good physical condition, maintaining or improving health, treating some disease or alteration organic, or simply enjoyment.

In the physical aspect, training seeks the development or improvement of physical qualities: strength, endurance, speed, flexibility, coordination and balance.

Resistance, or ability to perform activities through high oxygen consumption, plays a key role in most training programs

Cardiorespiratory endurance is the ability to withstand prolonged rhythmic exercise and is closely related to aerobic development.

Aerobic training can be defined as the structured program of activities that produce a series of peripheral and central adaptations designed to generate large amounts of ATP. Also, called endurance training or cardiovascular training.

Strength is the ability to move loads or endure a resistance.

Speed is the ability to perform motor actions in the shortest possible time.

Flexibility is the ability to stretch a muscle to the fullest and extend the gesture of a particular joint in a particular movement.

The training involves the performance of physical exercises designed to produce modifications and adaptations of the organism in order to improve performance. To achieve these beneficial responses, training must comply with general principles.

Responses and adaptations occur from a level of load or intensity of the exercise called threshold. Underneath it there is no response from the organism.

After performing an exercise, there is an alteration of the body that involves recovery mechanisms that provoke a superior response to the previous one of the effort, called supercompensation.

After performing the series of exercises and the training sessions, especially in the force, it is necessary to apply a rest period to assimilate the effort made. Otherwise, and if repeated and constant overloads are performed, not only will the desired beneficial effects be achieved, but also the risk of overtraining syndrome. Hence, the importance of recognizing that as important as the effort made in the preparation, is the rest, both in the training session itself and between the training sessions.

Finally, the athlete must perform the appropriate training to develop the qualities, especially physical, that he wants to achieve, and in this sense it is very important to program or choose the right exercise, with its number of repetitions and the appropriate load. Not always training more intensely, it is a benefit, but it can be counterproductive.

The return to calm

It is not advisable to end the sports activity suddenly. It is recommended that the athlete perform a period of return to calm, reducing the intensity of the activity instead of suddenly ceasing the same, especially if the training has been intense and if the athlete is old.

The return to calm has a number of beneficial effects on the athlete's recovery[127], such as a decrease in heart rate[128], or a decrease in the incidence of late-onset muscle pain[129], and some problems, such as hypotension or post-exercise syncope, are also avoided[130].

At the end of the training or competition a new series of stretches must be performed to reduce post-exertion rigidity and help normalize hypertonus and muscle congestion. These are passive static stretches, with progressive and slow tensioning of a muscle group with the help of an external force that can be the weight, gravity or help of another person. Stretching is maintained for 10-30 seconds up to 1 minute. They should be done in a comfortable position. This type of stretching is also indicated for the improvement or gain of joint mobility (flexibility training)[126].

The activity is finished with a shower, change of clothes, adequate shelter (if the environment is cold), replacement of liquids and carbohydrates, correct feeding and rest. These measures are basic actions after the training session or competition to optimize their benefits and be able to undertake a new session of effort to get the most out of it.

Incidental incidents in sports

During the practice of sports, there are some unforeseen situations where you have to react and seek solutions. In addition, intense physical activity may cause certain symptoms indicative of the presence of a disease such as syncope, dizziness, palpitations, chest pain, dyspnea, headaches and joint pain, among others. If any of these symptoms or any other suggestive of severity is noticed, the activity should be stopped and the doctor should be consulted.

Among the most common contingencies are the following.

1. Injuries. Injuries, due to intrinsic causes or extrinsic factors, are among the most frequent unexpected incidents in sports practice. They can be classified as mild, moderate or severe and the action will depend on whether they are open wounds, soft tissue injuries, fractures, injuries that can be a life threatening risk or situations that require a medical consultation[131].

Acting in the most frequent situations.

- *Mild Injury:* When a minor injury occurs (cramps, minor bruises, abrasions, scratches, blisters), a cure or emergency treatment may be attempted in order to continue the activity.
- *Wounds:* Wash with clean water and soap, apply antiseptic measures and contain the bleeding if it exists. If it is mild, it can continue the activity and if it is serious and precise suture or outpatient treatment the patient will be transferred to a medical center.
- *Epistaxis:* Nasal bleeding is common in contact sports. Usually do not usually take on gravity unless there is a fracture of the nose bones. The nose bleeds a lot so the correct thing would be to block the affected nostril, but if it is not possible to perform this maneuver, the athlete is seated and leaned forward and asked to tightly compress the nose with his fingers for some minutes, while applying cold packs to the nasal area.
- *Contusions:* Cryotherapy, anti-inflammatory therapies and, if severe, immobilization and transfer to a hospital.
- *Moderate or severe injury:* A moderate or severe injury (muscle breakdown, sprains, fractures, dislocations, or more severe injuries) necessitates interruption of the activity and medical services in search of treatment. In the fractures, you have to immobilize the best possible (sling, splint) and transfer the patient to a hospital.
- *Cranioencephalic trauma:* A fall or an accident doing sports can cause a head injury with serious consequences. Among the symptoms suggestive of severity are: loss of consciousness, nausea and vomiting, increased headache, seizures, impaired motor activity or pupillary inequality. Before an injury that affects head and / or neck, it is necessary to immobilize the neck, to evaluate if it is conscious, to make an evaluation of the damage and to transfer the patient to a hospital center as soon as possible.
- The attention of the field injury focuses on cryotherapy (except in wounds) and rest of the affected part. In the case of a dislocation, sprain or fibrillar rupture, rest, cryotherapy, immobilization if necessary, elevation of the affected limb (RICE) and transfer to a medical center if the injury is serious.

2. Stings and bites. In outdoor sports, there is a risk of insect or spider bites or bites from snakes or other animals. The stings and bites involve localized pain, edema, erythema and itching, in addition to risk of allergic reaction.

Action: Before a sting or bite you have to wash the affected area, remove the sting if possible, disinfect and apply cryotherapy. Ticks should be gently extracted to prevent them from breaking. In cases of allergy, antihistamines should be provided as well as corticosteroids and, if necessary, subcutaneous adrenaline and health center displacement. It is important to monitor anaphylactic shock that may occur in some people in a matter of minutes after the bite and requires urgent hospital treatment.

3. Heat stroke by effort. It is a type of hyperthermia (the temperature of the corporal nucleus exceeds 40ºC) caused by the ambient heat, in which the thermoregulation system fails. It is presented, especially, when three circumstances concur: thermal overload, intense physical exercise and dehydration. When the body temperature rises, the subject begins with caloric stress and ends up with a heat stroke whose most serious consequences are multiorgan dysfunction and cardiac arrest. It begins with dizziness, disorientation, hyperspiration at the beginning and lack of sweat later, followed by redness and dryness of the skin, hyperthermia, tachycardia, seizures, loss of consciousness and even death[132,133].

Action: The most important goal is to lower body temperature as quickly as possible for the prevention of organic damage and death. Therefore, it is necessary to put the subject in a cool place, in the shade, with the feet elevated, to remove the clothes and to try to cool him with the available means (air conditioning, cold baths...) and if it is possible rehydration and hydroelectrolytic restitution[133]. Additionally, you have to organize the urgent transfer to the hospital.

4. Freezing. It is a serious unforeseen that occurs mainly in winter sports. It is caused by exposure of the skin to low temperatures. When the skin is frozen, a white spot can be seen. The most vulnerable areas are the fingers and toes, the nose and the ears.

Action: Prevention is very important using warm clothing. Treatment will consist of heating the affected area as quickly as possible. Introduce frozen limb in warm water, cover frozen ears with warm cloths (do not heat frozen areas while remaining outdoors since they can be refilled) and seek medical attention as soon as possible.

5. Gastrointestinal discomfort. Relatively frequent in athletes, they usually appear when very intense training or competitions are carried out or if a copious meal has been realized shortly before. Symptoms may be nausea, vomiting, heartburn, diarrhea, esophagitis, or pain.

Action: You must stop the activity and perform the symptomatic treatment that is required.

6. Syncope or fainting. Consists of a sudden and transient loss of consciousness due to sunstroke, fatigue or hypoglycemia, among other causes. Patients feel dizzy and faint; tremor, loss of strength, blurred vision, dizziness, rapid and weak pulse, paleness, cold and sweaty skin occur.

Action: After checking that you are not in a cardiac arrest, you should knock the subject off by loosening his clothes and raising his legs 45º. If it is hot and under the sun, try to place it in the shade. Provide a drink and make a medical assessment of the cause that produced it when he recovers. In case you do not recover consciousness, monitor your breathing and pulse and call the emergency department.

7. Asthmatic crisis. Asthma is a very common disease and most asthmatics have respiratory symptoms when they exercise (if they do not take medication). In addition, other people have bronchial obstruction only when they engage in sports (exercise-induced asthma). In both situations, an asthmatic crisis can occur, which is a situation of severe respiratory failure and can become fatal if urgent treatment is not performed134.

Action: The first thing to do is to be calm and transmit that calm to the asthmatic patient and administer the rescue medication if the athlete takes it. These are inhaled bronchodilators that have an immediate effect. If the crisis does not subside within 5 minutes, the bronchodilator will be given again. If it does not stop, go urgently to a health center[135]. When a crisis occurs and rescue medication (inhaler or nebulizer) is not available, emergency services must be called immediately. Some measures of relief can be taken until their arrival; In addition to reassuring the patient and trying to breathe slowly, water vapor (from the shower) can relieve the crisis and theophylline from coffee or tea can also help dilate the bronchi.

8. Hypoglycemia in diabetics. Physical exercise should be a basic element in the treatment of any type of diabetes, but when doing sports there is an increase in the energetic needs of the muscle, so that in non-diabetics metabolic and hormonal modifications are produced that allow an increase of glucose release.

These metabolic modifications also occur in diabetics treated with insulin, but there is no automatic adjustment of insulin levels, so that hypoglycemia (rarely hyperglycemia), especially in type I diabetes, is not possible. Adjustments depend on the dose of insulin administered[136]. If not treated urgently, hypoglycemia can lead the patient to a coma.

Action: Hypoglycemia during or after exercise should be treated promptly with 15-20 grams of fast acting carbohydrates (sports drinks, sugary drinks or glucose tablets are adequate), and stop activity immediately. Severe hypoglycemia requires the help of another person for treatment; the treatment of choice in this case is glucagon[137].

9. Hypertensive crisis. It is an acute elevation of blood pressure that can threaten the patient's life. It is difficult to detect a rise in pathological blood pressure during physical activity. Training at submaximal levels of heart rate causes increases in systolic blood pressure, reaching values up to 210 mmHg.

Two situations can occur: hypertensive emergency that is accompanied by the failure of a target organ or hypertensive urgency where the elevation of blood pressure is not accompanied by acute organic damage. In the hypertensive crisis, the symptomatology presents with intense headache, but in the emergencies it is accompanied by neurological focal or some other symptom of severity (dyspnea, chest pain in patients with angina or visual alterations).

Action: Hypertensive emergency requires immediate reduction of blood pressure. If no therapeutic measures are available, a hospital should be urgently contacted. Hypertensive urgency requires reducing blood pressure within 24 hours to avoid complications[138].

10. Convulsions. Seizures are short episodes of involuntary movements that may affect one part of the body (partial seizures) or all of them (generalized seizures) and sometimes accompanied by loss of consciousness and sphincter control. They are produced by excessive electrical discharges of brain neurons and may consist of brief episodes of absence or muscle contractions to prolonged and severe seizures. Their frequency can also vary from less than one a year to several a day. In most cases, seizures are due to epilepsy[139].

The pathology depends on the part of the brain involved. There may be brief fainting, followed by a period of confusion, eye movements, uncontrollable muscle spasms, changes in behavior and mood, grinding of teeth, loss of sphincter control or sudden drop.

Action: Leave the patient laid down, protecting him from injury by preventing him from striking but not attempting to hold him during the attack, inserting a soft object into the mouth (handkerchief) to avoid lingual bites and allowing the patient to convulsion[140]. As a medication, diazepam can be used rectally if available; the rest of the measures will be hospitable. When you stop, convulsing check the breathing and the pulse, place it in a lateral safety position and transfer to a hospital. Among the worst unforeseen that can occur is the cardiac arrest. If this situation occurs, you should start with the subject's CPR and ask for help in emergencies.

The risk of sudden death in sports

Definition of sudden death in sports

Sudden Sport Death (SSD) is defined as an episode of cardiac arrest (CA) during physical / sports activity that leads to death within a period of up to one hour from the onset of symptoms[141,142]. However, there are authors who extend the period of death up to 24 hours after the onset of symptoms[143].

Although the prevalence of SSD is very difficult to quantify, it is estimated that in Spain there are 1.6 / 100,000 SSD per year[141], as in other contexts[144,145].

Causes of sudden death in sports

Although there is a percentage of SSD in which the cause is not discovered, especially in young athletes, where necropsy is termed "white"[141] 75-95% of SSDs are directly or indirectly caused by cardiovascular causes[146-148].

The ultimate cause of SSD is primarily a malignant arrhythmia[145] and is exceptionally due to diastolic arrest or rupture of a large vessel. The responsible arrhythmia is ventricular fibrillation (VF), sometimes as degeneration of a tachycardia or ventricular flutter (VT, FLV).

The initial cause of terminal arrhythmia is usually a cardiovascular disease (CD) that is the arrhythmia inducer. In people under 35, diseases with hereditary or congenital disease predominate, and above this age, the cause would be coronary disease.

Illnesses with risk of sudden death in athletes under 35

Hypertrophic cardiomyopathy

It is an abnormal development of ventricular cardiac muscle fibers of complex genetic cause that causes an inappropriate increase of the thickness of the ventricular walls, frequently in the subaortic section of the septum. However, it can be found in other locations (apical, posterior wall, basal segments, even global or symmetric)[149].

The dissemblance of the muscle fibers generates reentry circuits that provoke the arrhythmic process. In this context, frequent and complex ventricular extrasystole degenerates into VT or VF.

Hypertrophic cardiomyopathy with more marked hypertrophy and / or dynamic narrowing of the most significant left ventricular outflow tract are the ones that present more episodes of SD whereas physical exercise is the inducer of extrasystolic precursor to malignant arrhythmia.

Ventricular arrhythmogenic dysplasia

It is a degenerative process that affects the ventricular muscular tissue, creating islets of fibrolipidic cells in the heart of the ventricular wall. It is a disease with a large familiar / genetic component, with an autosomal dominant inheritance. Nevertheless, there are recessive forms (Naxos disease, Carvajal syndrome)[150], apparently all related to autosomal malfunction. It can affect any of the ventricles, but more to the right, in the area that encompasses ventricular inlet, outlet and apex.

Around these fatty islets anatomical circuits that facilitate reentry are formed and consequently arrhythmias (ventricular polytropic extrasystoles) very difficult to control by the multitude of places where it is generated. Such arrhythmias may be the trigger that initiate a malignant arrhythmia leading to sudden death.

Canalopathies - Brugada Syndrome

Canalopathies are a group of diseases recently described[151] that are the result of a genetically transmissible anomaly characterized by the malfunction of ionic transmembrane ion channels and the consequence of which is the appearance of SD by malignant arrhythmia in youth. They are alterations that can be detected in subjects with an appropriate family history and syncopal clinic, together with certain electrocardiographic alterations. The most classic, Brugada syndrome[152], has a special morphology, somewhat similar to the incomplete right bundle branch block in young people, which probably went unnoticed for years.

Congenital coronary heart disease

The anomalous development of the coronary arteries, with anomalous exits of the aorta, may be unnoticed, but cause an MS during physical exercise in youth, as the first manifestation of the anomaly.

There is a greater risk, especially when an abnormal vessel passes through the crossroads between the pulmonary artery and the aortic root, because of the possibility of compression during the exertion, and more especially when the coronary artery has an intraparietal path in the wall of the aorta, in which the risk of compression with exercise is especially high. Ischemia during exercise induces malignant arrhythmia leading to SD. These abnormalities do not usually cause exertion angor or nonspecific discomfort. In addition to that, the resting ECG is usually completely normal.

Aortic valve disease

The abnormal development of the aortic valve is moderately frequent, but is only hemodynamically significant when the degenerative process causes functional failure of the valve due to altered hydrodynamic conditions. However, there is a small number of cases in which the structural alteration of the valve generates a stenosis already in the youth. With exercise, pressure overload imposed on the left ventricle can induce malignant arrhythmia and lead to an SD.

Marfan syndrome

It is a consequence of an autosomal dominant genetic disorder that alters the development of fibrillin[153]. It is a syndrome with alterations in various locations, such as bone or ocular, among others. Nevertheless, the significant risk of SD is due to degeneration of the middle layer of the aorta. In the effort, the unstructured aorta can be dissected and ruptured, resulting in death by internal massive hemorrhage.

Mitral prolapse

It is a valve alteration in which the mitral folds and introduces into systole in the atrium, producing valve regurgitation. It is usually found within a hyper-looseness of the conjunctive system[93,154].

It is common to find flexible mitral and tricuspid valves in young people, but there is only prolapse if laxity causes the valve to fail. In such a case, it is accompanied by arrhythmias that can trigger an SD due to malignant arrhythmia, and there may even be a ruptured valve that causes massive mitral regurgitation related to an isometric effort.

Dilated cardiomyopathy. Myocarditis

Myocarditis is an inflammatory process usually secondary to a viral infection that affects ventricular contractility and generates arrhythmias, but it is usually accompanied by few symptoms[93], making it difficult to diagnose. Physical activity with myocarditis is at risk of malignant arrhythmia. Dilated cardiomyopathy, which is uncommon in athletes and may be a sequela of acute myocarditis,

presents a risk of malignant arrhythmia in intense physical exercise. Some features of dilated cardiomyopathy may be similar to those found in overtraining syndrome[155].

Diseases with risk of sudden death in athletes older than 35 years

Ischemic heart disease

Coronary artery disease begins in youth, but until its development is sufficiently important there is no risk of an acute episode. In this case, it may cause a malignant arrhythmia due to acute ischemia, or an acute arterial obstruction that in turn triggers the malignant arrhythmia[93]. Only in the case of genetic dyslipidemia not detected with accelerated atherosclerosis, or in the case of an early ischemic familial disease an SD in children under 35 years can occur.

Dilated cardiomyopathy

It is an entity of varied cause (genetic, idiopathic, alcoholic, myocarditic, ischemic, etc.) that presents risk of MS due to malignant arrhythmia.

Prevention of sudden death in the sportsman

The prevention of SSD is based on the detection of the causes that can provoke it. This is especially problematic in the under 35 years, due to the great amount of illnesses and alterations that can provoke it, reason why the current recommendation[93] is the assessment of the pathological, family and personal antecedents, and the data of the clinic and the exploration with greater capacity to detect anomalies. The consensus of the scientific societies of Sports medicine and cardiovascular diseases establishes the indications gathered in Table 7 [76,89-96,99].

For the prevention of SSD it is necessary to make a medical examination for sports fitness with cardiovascular history, taking into account the family and personal history and the possible existence of symptomatology. Physical examination includes an assessment of the overall appearance, pulse palpation and cardiac auscultation and 12-lead resting electrocardiogram. In athletes over 35 years of age, an exercise test will be performed to assess ischemia, being unnecessary to assess functional capacity to rule out coronary disease.

Depending on the findings of the examinations, several complementary examinations may be necessary to complete the study: echocardiography, stress echocardiography, high resolution cardiac / coronary tomography and angiotomography, cardiac magnetic resonance imaging and angioresonance, dynamic electrocardiogram by Holter technique, electrophysiological study, cardiac or coronary catheterization, or genetic testing, among others.

Table 7. Contents for physical examination.

Age	PE	CEX
<35 years old	Anamnesis Physical exploration Electrocardiogram	Yes
>35 years old	Id. + Stress test	Yes

PE: Physical examination. CEX: Complementary examinations.

Table 8. Treatment for sudden death of athletes.

SDA	Treatment
(CAR, CAM)	Public semiautomatic defibrillator placed where sports are practiced Emergency advice Basic knowledge about CPR.
About the illness	After a SDA or as a prophylaxis of it

SDA: Sudden death of athlete. CAR: Cardiac arrest. CAM: Cardiac arrhythmia. CPR: Cardiopulmonary resuscitation.

Treatment of sudden death of the sportsman

The treatment of SSD has two components: the occasional treatment of the episode and the treatment or management of the underlying pathology (Table 8).

The treatment of the episode of SSD can be done by health personnel, but also by any other person. In order to be able to reverse the arrhythmia, a defibrillator must be available and basic cardiac (or cardiopulmonary) resuscitation should be initiated[156,157]. The presence of semiautomatic defibrillators in public sports spaces, for which special training is not really necessary because the equipment indicates the instructions clearly, frequently allows to keep the patient alive until the arrival of the emergency service. However, it is very appropriate to carry out resuscitation training for the staff of the sports facility.

Treatment or management of the underlying disease, which may involve avoiding the occurrence of new episodes of SSD, should be addressed by appropriate clinicians and beyond the scope of this document.

Consequences of excessive sport

The benefits of sport have been well described and stand out due to their importance in increasing and ensuring adherence to the sport. The feeling of well-being, the change in the body composition and the improvement of the self-image, the socializing effects, the increase of the vitality, etc., positively encourage the continuity of the sport practice. However, false myths and lack of medical-sports control, among other factors, can lead to the adoption of erroneous habits of exercise and food in order to maximize at any cost the most

hedonistic and narcissistic effects of the exercise, leading to situations which increase the risk to both physical and mental health.

The main risks from this point of view are the addiction to sports and vigorexia, whose repercussions of greater importance on health are the syndrome of overtraining and chronic fatigue.

Addiction to sports

Although the term addiction to sports may seem excessively forceful at first glance within the sports field, this concept defined in the last decades is well consolidated with a solid scientific suppport[1,158].

The first description of the phenomenon of exercise dependence was made in the 1970s by Baeckeland[159] when investigated sleep patterns and psychological reactions caused by exercise deprivation in athletes. Their results showed that after the deprivation of exercise there were alterations in the pattern of sleep, increased sexual tension and anxiety, along with the need to be with other people.

At the end of the same decade Morgan[160] first used the word addiction to define the patterns of daily and almost obsessive behavior of athletes who practiced jogging and who wanted to compulsively repeat the sensation of euphoria that this exercise produced, even if there were injuries due to over-stress.

The most accepted definition of addiction or dependence on sport is the urgent need for intense physical exercise in both frequency and duration, feeling of an irresistible impulse to do it, exercising even in the presence of injury or tiredness. When the work and personal commitments prevent from practicing sport, somatic and psychological symptoms might occur[161].

Addiction to sports is especially striking because it is the only case where more expenditure of energy and physical effort is required. But, however, it fulfills and shares all the conditions that define an addiction: dependence, tolerance, or withdrawal symptoms. In sports addiction subjects evolve from the experience of the exercise as a diversion, until becoming a necessity and obligation[162]. In fact, sports practice can become an obsession (in reference to non-professional athletes) when it is carried out in an excessive, continuous, maintained and intense way, leading in the most extreme cases to addiction or dependence to exercise. This progression is based on the following phases described by Freimuth et al.[163]:

- *Phase 1:* Exercise is a recreational and enjoyable activity, and the athlete controls his behavior, with minor negative consequences such as mild muscular pain.
- *Phase 2:* Risk exercise. The effects of exercise that modify mood are discovered, using these to cope with daily difficulties. Addiction is more likely to occur when exercise becomes the first way to combat stress.
- *Phase 3:* Problem exercise. Daily obligations are rigidly subordinated to the practice of the exercise, with negative consequences arising since the exercise is carried out individually and under different models of activities.
- *Phase 4:* Addiction to exercise. Control over exercise is lost, and tolerance effects appear. Daily obligations go secondary and the primary goal is to avoid the symptoms associated with abstinence.

This type of exercise addiction has to be differentiated from that which is secondary to another cause, as in the case of anorexia nervosa, where exercise is used to expend energy and lose weight, rather than as a means of dealing with psychological alterations[164].

The incidence of sports addiction is 3% of the population that does sport158, although the results vary according to the criteria and methodology followed in the studies (from 0.3% to 77%).

The dependence on the sport is manifested by: the pleasant state that produces the realization of the exercise, the tolerance for the need to progressively increase the frequency and intensity of the exercise to obtain the same rewarding feeling, the leading to increased exercise without control and in the case of abstinence, symptoms occur due to deprivation of exercise, such as exhaustion, fatigue, depression, loneliness, weakness and irritability[161].

Although it is not easy to differentiate the limits between healthy and excessive or infirm, in the dependencies, the physical and psychic symptoms facilitate the verification of own and specific behaviors of the addiction to the sport. There are specific and validated questionnaires for the detection of this alteration[161]. The SAS (Sport Addiction Scale) questionnaire consists of 40 items with a high capacity for specific detection of addiction[161] (Table 9).

Although these types of questionnaires are aimed at professionals, the reading of questions by athletes can help raise awareness of behaviors that together may reflect behavioral changes, and thereby help prevent reactions that can lead to long term to the addiction.

Vigorexia

Vigorexia refers to a disorder first described in 1993[165], initially named "inverse anorexia nervosa" or "bigorexia". It is an emotional disorder of the obsessive-compulsive type, with constant thoughts about the need to exercise, for which compulsively practice generally intense exercise. There is a distorted perception of the image itself, seeing itself as weak and without musculature, and occurs more in males, aged between 18-25 years, and courses with low self-esteem.

In many cases the athlete consumes anabolic substances, which together with the repeated and intense exercise, greatly increases the risks to the athlete's health.

Figure 1 shows the vigorexia model proposed by Lanz et al.[166].

Overtraining Syndrome

The consequence of repeated and intense practice in the case of sports addiction and vigorexia, with little recovery time and rest, is the accumulation of fatigue that can ultimately lead to overtraining syndrome, with serious repercussions for health.

Overtraining is a global physical and psychic response to excessive exercise that reflects inadequate assimilation due to lack of

Table 9. SAS (Sport Addiction scale) (Retrieved from Antolín *et al.)*[161].

1. I practice exercise regularly.
2. I usually practice sports outside even when weather is bad.
3. I have changed a family activity to practice exercise.
4. I did not leave exercise when I was ill or had an injury.
5. I have kept practicing exercise even if I had any pain.
6. I have the sensation that I buy too many books, video, material, food or drugs related to sports.
7. I would keep practicing exercise to be fit even if there was an easier way to get it.
8. I feel better after practicing exercise.
9. I have practiced exercise before being totally recovered after an injury.
10. Some days I make myself to do exercise when I do not want to do it.
11. I need to practice exercise at least once per day.
12. I have been criticized by my friends due to practicing sports.
13. If I lose a training, game, etc. I get angry or I feel guilty.
14. Very often I am thinking about practicing sports while I am doing other things.
15. If I don't practice exercise one day, I feel that I am less fit.
16. I haven't gone to a date for practicing exercise.
17. Exercise is like a drug for me, I always want to practice it.
18. I have had an argument due to the time I spend practicing exercise.
19. I usually practice exercise to liberate from stress and anxiety.
20. If I do not practice exercise, even for a short time, I feel sad, angry or guilty.
21. I have progressively increased the frequency or quantity of exercise.
22. I have tried to stop doing exercise for a while but I have not got it.
23. I use so much time for activities related to sports, such as television, books…
24. Exercise has produced me fatigue or decreases on performance at my job.
25. I often adapt the other activities to the Sport I like to practice or watch.
26. I practice exercise to feel better with my body.
27. Sometimes I use job time for practicing exercise.
28. I have a sensation that if I don't practice exercise, I will lose social relationships.
29. I feel that if I do not practice exercise, I lose the control of my weight.
30. Sometimes I felt guilty because of practicing so much exercise.
31. When I do not practice exercise, it is like I have something left.
32. I often try to practice less exercise, but I do not get it.
33. I try to practice the same quantity of exercise every week although I have difficulties.
34. I often justify the exercise I practice as a way to prevent injuries illness.
35. Sometimes I practice more exercise to keep my weight.
36. I usually have well-being sensation when I practice intense exercise.
37. I do not stop practicing exercise if weather does not let me go outside.
38. Some of the people who practice exercise with me, is an addict to sport.
39. I am worried about not having time to practice exercise.
40. Sometimes I have been pointed as an addict to sport

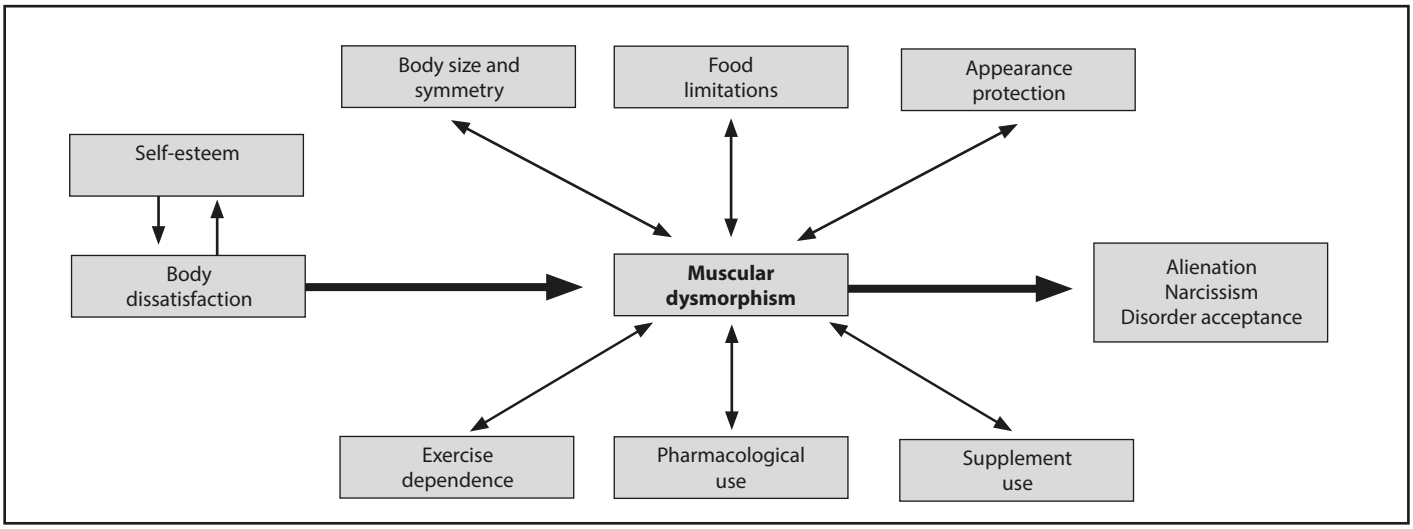
Each item has two possible answers. YES/NO

rest, nutritional imbalances or sustained emotional stress, causing alterations in multiple body systems (neurological, hormonal, immunological) and with changes in mood and behavior[167].

This situation can be observed in professional athletes, but also in those who practice recreational sports, especially when there is addiction or vigorexia and does not take into account the rest of habits and living conditions (work, hours of rest and sleep, stress, etc.). This can undoubtedly make difficult the assimilation of such an exhaustive training.

Decreased sports performance is the common symptom of all overtraining cases. However, confusion may arise in the diagnosis of this syndrome if the period of decreased performance is not determined. In fact, in training, it is normal to decrease performance for a few hours after each training session, or for several days at the end of a micro or training macrocycle. However, when the decrease in performance is maintained for many weeks, it is referred to as muscle fatigue syndrome and when symptoms persist, despite the rest, symptoms of overtraining are mentioned.

Figure 1. Model of vigorexia. Retrieved from Lanz *et al.*[166].



In many of the cases of overtraining, important nutritional imbalances are observed (increase of protein consumption, reduction of fat and carbohydrate consumption, etc.) that favor the delay of the processes of recovery and assimilation of the training.

The clinical manifestations of overtraining can be very diverse depending on the stage and overall health of the athlete (Table 10).

In general, minor muscle damage (mild acute inflammation) occurs during exercise, and recovery requires a sufficient amount of rest and nutritional and water supply to restore the previous initial state and allow a new training session to be performed in perfect conditions. When some of these factors are not taken into account, and the recovery has not been complete, the accumulation of fatigue can lead to a chronic alteration, which, if not resolved, can lead to overtraining syndrome. For this reason it is so important that athletes know the symptoms that can appear in the successive phases of this process, and that if they are detected early, they will return to the desired level of performance and avoid greater risks if the alterations are perpetuated[168].

Athlete alimentation

General characteristics

The human diet is considered balanced when it provides energy and nutrients in sufficient amounts to maintain the body's

Table 10. Symptoms produced by overtraining (Retrieved from Smith LI)[168].

Performance	Biochemistry	Psychological
Decreased performance	Decreased serum ferritin	Feelings of depression
Fever	Decreased serum iron	General apathy
Insomnia and night sweats	Decreased hemoglobin	Fear of competition
Irritability and nervousness	Depressed muscle glycogen concentration	Difficulty in concentration
Reduced work capacity	Mineral depletion (Se, Co, Al, Zn)	Emotional instability
Tachycardia	Increased urea concentration	Sensitive to stress
Increased blood pressure	Elevated cortisol levels	Increased distractibility
Increased recuperation time	Low free testosterone	Decreased self-esteem
Decreased coordination	Ketosis	Changes in personality
Headache	Decreased ratio to free testosterone	
Decreased appetite	to cortisol of more than 30%	
Nausea		
Amenorrhea		

functions, in a context of physical and mental health. It is specific to each individual and adapts to their age, gender, weight and health status. There are several factors that influence the balance of the diet, including physical activity.

The amateur or recreational athlete, who performs physical activity with simple requirements, must follow a varied and balanced diet in quantity, quality and regularity, including all food groups (milk and byproducts, meat, fish and eggs, potatoes, legumes and nuts, vegetables, fruits, cereals, honey, sugar and sweets, and animal and vegetable fats[12].

It is important to take into account the schedule of the meals, respect to the program of physical activity (time of day, duration, intensity and type of exercise).

It may be necessary, depending on the characteristics of each person and the individual objective of the sport practice, to increase the caloric intake and of certain nutrients, according to the following recommendations.

Energy needs

A person who performs moderate exercise, 30 - 40 minutes a day, 3 times a week, can cover their energy needs by following their basal diet (1,800 - 2,500 kcal / day or 30-35 kcal / kg / day for a person 55 - 80 kg) as the caloric demands during physical activity are usually not high (200 - 400 kcals / session)[169].

Some amateur athletes perform very intense workouts (for example 2-3 hours a day, 5 days a week). These people may spend between 600-1,000 kcal per hour of exercise, reason why their energetic demands will be increased.

Carbohydrates (CHO)

Recreational athletes who practice exercise more or less regularly can meet the needs of this macronutrient through their usual diet, consuming approximately 50-55% of the total daily calories in the form of CHO (3-5 g / kg / day). However, if the volume of exercise is moderate-intense the requirements are greater. For example, if physical activity is performed for 2-3 h / day, 5-6 days / week, CHO needs increase up to 65% (5-8 g / kg / day).

It is convenient that most of the daily intake of this macronutrient comes from sources of complex CHO with a moderate or low glycemic index (whole products, vegetables, some fruits, etc.)[170,171].

However, during physical exercise longer than 1 hour, it is recommended to consume drinks with fast absorption carbohydrates[124].

Proteins

The initial recommendations for active people are the same as for the general population (0.8-1 g / kg / day for children, adolescents and adults). However, for amateur athletes performing moderate-intensity training these amounts are not enough and need to increase protein intake (1-1.5 g / kg / day)[172].

Fat

The consumption of fats in active people helps maintain energy balance, replenishes deposits of intramuscular triglycerides spent during exercise and provides the essential fatty acids, essential for maintaining an adequate state of health. Fat consumption recommendations for amateur athletes are similar to those of the general population, around 30% of total caloric intake, always paying special attention to the type of fats to be consumed (saturated fat less than 7%, monounsaturated above 17%, polyunsaturated for the rest).

Total fat consumption may vary depending on the purpose of each person (for example weight loss) and the type of training and / or sport practiced.

Vitamins and minerals

Vitamins and minerals are essential to regulate the metabolic processes of the body and provide great health benefits. In general, with some exceptions, they have not been described as increasing physical performance unless there is a deficiency of some of these elements and their supply is necessary. It is accepted that recreational athletes, if they follow a sufficient, varied and balanced diet, do not need to take any supplement, only if they take adequate daily intakes, but there is no consensus on the specific requirements regarding the amount of vitamins and minerals that has to take an athlete who performs a higher intensity activity[173].

People on calorie restricted diets may have deficits in certain vitamins and minerals. Many people perform physical activity in order to lose weight, some authors recommend consuming a daily low-dose vitamin and mineral preparation in order to prevent possible deficiencies and promote good health in the general population[174].

Hydration

Generally, recreational sports are carried out at low-moderate intensity and in short time. Although it is convenient to drink fluids during exercise, its acute replacement with certain guidelines is not usually necessary. However, it is always important to start exercise well hydrated and recover lost fluid with adequate rehydration at the end of training. In people who exercise at high intensities or with prolonged duration (> 1h) and / or in a hot environment, it is necessary to drink beverages with CHO and electrolytes, with the aim of preventing water losses greater than 2% of body mass and avoid a possible heat stroke[124].

Recreational athletes can use hydration markers in order to know their water needs, such as urine color, changes in body weight before and after exercise, and perception of thirst sensation.

An alteration that can occur as a consequence of a poor hydration strategy is the water intoxication with hyponatremia (blood decrease of sodium concentration) that has been described in long-term competitions in amateur athletes, in which the participants ingest too much liquid without sodium intake enough. Symptoms

include headache, nausea, vomits, weakness, cramps, disorientation, incomprehensible language, mental confusion, lethargy, convulsions, pulmonary edema, coma[175], and death[176].

Nutritional supplements and ergogenic aids

There are many athletes who consider that adequate nutrition and hydration, along with the rest of appropriate preparation strategies, are not enough to achieve their performance goals and start using nutritional supplements and ergogenic aids.

A nutritional supplement is defined as a substance or the amount of a substance necessary to supplement a person's adequate dietary needs.

It is understood as ergogenic aid "any method (nutritional, physical, mechanical, psychological or pharmacological) performed in order to increase the capacity to perform physical work and improve performance"[177].

Generally, neither nutritional supplements nor nutritional ergogenic aids are necessary, much less when we talk about recreational athletes. Only a doctor can decide if that kind of prescription is necessary.

The products that are marketed as ergogenic aids and nutritional supplements, all of them legally regulated, almost all of them do not have scientific evidence to prove their usefulness. Those who have shown an utility do not have, for the most part, incontrovertible recommendations of use, since their effectiveness may depend on multiple variables related to the athlete (age, sex, nutritional status and hydration, immunity, fatigue...) and kind of sport (type, load and effort time, physical training, extreme temperature conditions, humidity, altitude, among others)[178,179]. For this reason, it is indispensable to use them for individual prescription, according to their dose, secondary effects and contraindications, and recommended as a complement to a planned diet[171,179].

Ergogenic aids and nutritional supplements, which are widely available on the market, often have a clandestine and illegal origin and, in this case, there is not any guarantee and safety, it can even happen that the content does not correspond to what is indicated on the label 12. This fact makes its consumption, besides a health risk, an adverse analytical finding in a doping control and to the corresponding sanction.

There are studies that have found up to 15% of nutritional supplements with substances not indicated on the label and that could lead to an adverse analytical finding in a doping control[178,180].

A balanced diet that is adjusted to the individual energy expenditure covers the needs in energy and nutrients being enough to cover the demands of the physical effort[179,181]. As a reference for dietary adjustment, the recommended daily intake for energy and most important nutrients is established for the general population and even for occasional, moderate and intense athletic practice[182,183] setting the maximum safety limits or TUILs (Tolerable Upper Intake Levels) for the amounts of minerals and vitamins[183-185].

An individualized nutritional assessment is recommended to advise on the appropriate dietary habits to ensure an optimal contribution in nutrients and especially if they are vegetarian diets, due to the variety of existing trends[179,181,186-188].

The use of medicines in sport

Taking medications in sports can be due to two main reasons: first, as a treatment of acute or chronic symptoms, injuries or illnesses, and secondly, with the aim to improve performance, making easier the assimilation and recovery of training. This second group also includes the use of drugs related to doping, which presents a special consideration due to its health and legal implications.

The use of medicines in competition and in its preparation is very high. In football, half of the players use nutritional supplements and medications, being nonsteroidal anti-inflammatory drugs (NSAIDs) the most commonly used, followed by beta-2-agonists, inhaled corticosteroids and injected corticosteroids[189,190].

In any case, medication prescription is an action performed by doctors, as part of the most suitable treatment for each athlete. Although the doctor must know all those pharmaceutical preparations that contain doping substances, and must inform the athlete about it, the taking of these substances has only a legal and administrative importance when the athlete is competing and is subject to doping controls.

Drug intake can also have effects that positively or negatively influence on sports performance. For example, beta-blockers indicated in patients with hypertension, decrease heart rate and blood pressure which affect sports practice. These effects should always be communicated to the patient, when the patient is an athlete.

Problems can appear when it is the athletes themselves or non-medical people who recommend taking drugs or other substances or nutritional supplements. In these cases, the pharmacological composition (in the case of medicinal products) or the nutritional composition should always be taken into account and checked against the lists of forbidden substances, published in the Official Gazette[191].

in this situation, it is convenient for doctors and athletes to follow the recommendations of the Spanish Society of Sports Medicine SEMED / FEMEDE[192] about the consumption of drugs and substances that may interfere with performance, especially in cases where they may be subjected to doping controls, and which are summarized in the following points:

- Managers of sports institutions (clubs, sports associations, etc.) should have information on the current situation of doping, and make available to athletes recommendations regarding the intake of medicines and other pharmacological substances, especially in those cases when they may be subject to doping controls (remember that in some sports, young athletes are

called to participate in competitions subject to doping controls, which is not an impediment to pass such controls).
- Athletes should receive information through clubs, sports associations and sports federations on:
  - The concept of doping, doping control regulations and substances and methods that may lead to the appearance of positive results in doping controls.
  - Internal regulations, regarding the use of medication and other substances that will be carried out in this sports entity.
  - Commonly used drugs (anti-fluids, analgesics, etc.) that can produce positive doping results.
  - Medications of common use that can be used by the athlete without containing substances capable of presenting positive doping results.

Regarding this, the full text of the most recent list of banned substances and pharmacological groups and non-regulatory methods of doping in sport, and the specific regulation of each sport concerning doping, are particularly indicated.

Table 11 shows the normative model on doping control to be applied in sports organizations.

The document on recommendations for drug consumption published by SEMED / FEMEDE[192] also includes preparations that do not contain doping substances and are frequently used. It is important in this list to pay attention to the full name of the permitted drug, since some different preparations of the same drug may be included in the list of prohibited substances. Table 12 shows in an orderly way by systems, the preparations that can be used due to that they do not contain doping substances.

Table 11. Normative about doping control to apply on sports organizations (summarized and retrieved from SEMED/FEMEDE)[192].

- Doping is the use or administration of substances or the application of methods for the artificially increase of athletes physical capacitation or modifying competitions results, but from legal point of view, doping is considered as any infraction to doping rules[193]
- Licensed athletes, who participate in state's official competitions, have the must to go on doping controls, which can be done during official competitions or anytime out the competition
- Every substance including any active ingredient which could be cataloged in the list for forbidden drugs and not valid methods, are forbidden
- In some concrete sports, the organization has the obligation to have a record book, signed by the pertinent federation, where every drug prescribed to athletes by the team doctor must appear
- In some concrete sports, the organization give a closed envelop to the main referee containing what drugs have been provided to each athlete for the last 48 hours
- These infractions are considered very grave by actual regulation:
  - Promotion, incitement, consumption or using forbidden drugs and not valid methods, with the aim to artificially increase athlete's physical capacitation or modifying competitions results
  - Refusing to go on doping controls done by appropriate people or organizations, or any action which could perturb the correct realization of these controls
- People declared as responsible for doping infractions will receive a penalty by actual regulation
- People declared as responsible for doping infractions will be penalized by actual regulation
- If an athlete is temporally suspended less time than time remaining for the season's end and keeps his license updated, he will have to be available for doping tests during suspension time. If sanctioned before of suspension period, athlete will have to go on to a new doping control. If any doping use is detected, it will be taken as a new infraction
- Athletes must consult to the sport's organization doctor in order to get any type of drug (oral, injectable, rectal, dermatological and any other).It also must to be asked for natural preparation, proteins, amino acids , herbs, etc. This includes any other prescription done by other doctors
- If preparation has been previously authorized, athlete must communicate to his club's doctor its use
- Any doubt about any drug or any other preparations, must be consulted with sport's organization doctor
- It must never be accepted food or drinks from people unconnected with sport's organization
- Not reading this communication by athletes, is responsibility of athletes and supposes the immediately communication to the sport's club or organization for any reason

Doping in Recreational Sports

Doping is an inherent phenomenon of sport that appeared with it[193] and, as time goes on, unfortunately has a more prominent place in the context of sports practice.

Doping, from a practical point of view, is defined as the commission of one or more offenses covered by the World Anti-Doping Code[194], but from a conceptual point of view, doping is understood as the use of prohibited substances or methods to improve sports performance and is called intentional doping.

The amateur athlete is exposed to doping in several ways. Firstly, to be decided to use doping procedures deliberately, which is understood as intentional doping, to improve their performance and achieve sports results as victories in popular competitions or to improve the physical appearance. It is not known the extension of this type of doping, but there are several data suggesting a high utilization, as in the USA, in a study of the previous decade, between 1 and 3 million athletes had consumed anabolic androgenic steroids (EAA), Independently of other substances[195], and there are studies that advice about the use of doping products by recreational athletes, such as the use of anabolic drugs in 12.9% of men and 3.6% of women in gyms In the German area of Frankfurt / Main[196], or the use of ergogenic anabolic substances in German fitness centers[197].

In the Spanish context, there are no studies about the use of doping substances in this kind of athletes, but it must be an important phenomenon due to the perception of many amateur athletes and the large number of police operations with hundreds of accused and under arrest people and hundreds of thousands of seizures of doping products in recent years.

What is more frequent is that an unintentional form of doping occurs in its two different forms: inadvertent doping and accidental doping. In inadvertent doping, an unknown drug, containing forbidden substances is used without requesting authorization for therapeutic use. Accidental doping occurs when consuming substances (food supplements, nutritional substances or ergogenic aids) containing prohibited substances that are not declared in their composition.

For all these reasons, doping prevention strategies must be developed, being justified on the following grounds:

- Prevention of health.
- Avoiding the presence of an adverse analytical finding in a doping control. There are amateur sports events that perform doping checks.
- To avoid that there are athletes who use illegal advantages against their competitors to preserve the meaning of the sport.

However, the most important concept in relation to doping is that the athlete understands and accepts, acting in consequence, that doping is not acceptable in order to compete in same conditions as other athletes and to protect his health.

Table 12. Drugs not containing doping substances (Retrieved from SEMED/FEMEDE)[192].

Digestive system

- ORAL BETADINE * MILROSINA * SANODIN GEL * LIZIPAINA antacid. * ALMAX anti-ulcer * ZANTAC * QUANTOR
- Anticholinergic. *CLEBORIL *DUSPATALIN *SPASMOCTYL
- Antiemetic. BIODRAMINA * PRIMPERAN * TOREXAC laxative. *EMULIQUEN LAXATIVE * EVACUOL
- Antidiarrheal. * FORTASEC
- Vitamins. * PHARMATON COMPLEX * MULTIBIONTA MINERAL

Restorative

- AMINOVEINTE

Blood and antianemic hematopoietic system

- CROMATONBIC-FERRO * FERROPROTINA * FOLIFERRON *

Cardiovascular system.
Varicose veins and hemorrhoids preparations

- VENOSMIL * INTERCYTON

Dermatological preparations

- Antifungal. CANESTEN * MYCOSTAIN * DAKTARIN
- Antipruritic. * TALKISTINA
- Topical antibiotics. *IRUXOL MONO * NEO-BACITRIN
- Topical corticosteroids. * MENADERM SIMPLE
- Antiseptics. MERCROMINA * ARMIL * BETADINE
- Anti-acne products. MINOCIN * LODERM * LEDERPAX

Genital-urinary preparations. Urological antiseptics and anti-infective

- FURANTOINA

Anti-infective by general way

- ARDINE * CLAVUMOX * PANTOMICINA

Musculoskeletal system. Anti-inflammatory anti-rheumatics

- FELDENE * ENANTYUM * VOLTAREN * AIRTAL
- Local anti-inflammatory. FASTUM GEL * VOLTAREN EMULGEL * HALOGEDOL
- Muscle relaxant. ADALGUR * ROBAXISAL * YURELAX

Central nervous system. Analgesics anti-thermic

- ASPIRIN * AAS * GELOCATYL * NOLOTIL
- Tranquilizers. * ANEUROL * LEXATIN * TRANXILIUM
- Dizziness in travel. * BIODRAMINA * TORECAN

Respiratory system. Nasal decongestant

- * RESPIR

Mucolytic

- * MOTOSOL * FLUIMUCIL

Anti-flu

- * ASPIRINA * GELOCATYL

Antihistamine

- * HISTAMINOS

Health Effects

One of the main reasons for avoiding doping, and one of the causes of prohibition of the World Anti-Doping Agency, is the potential risk to the athlete's health of the prohibited substance or method[194].

This agreement document does not seek to give a detailed description of all the health effects of forbidden substances and methods, but only the most important and related to the most likely substances used in amateur/recreational sport, as androgenic-anabolic steroids (AAS), erythropoiesis stimulants, central nervous system stimulants and cannabis.

Mostly, adverse effects of doping substances depend on many factors, but the most important are the doses used (the effects of AAS are dose-dependent and increase as dose increases), the way to intake (in general, parenteral administration has more side effects, but oral administration of AAS, due to its metabolism, has very serious effects on the liver), the combination of substances which is very frequent in anabolic procedures, the presence of pathology In the athlete and, lastly, the origin of the substance that is very dangerous if it comes from clandestine laboratories, which makes not to ensure its dose, its manufacturing process and even that if it is the substance indicated in the leaflet.

Anabolic steroids androgens

AAS are the most detected doping substances in doping controls and probably the most used by athletes with the intention of increasing muscle mass and strength. Therefore, they are used mainly in power sports (weightlifting, speed, jumping and throwing of athletics, combat sports, rowing, canoeing) and in corporal appearance activities (bodybuilding).

Due to that their action occurs in receptors which are distributed throughout the entire organism, AAS have side effects on most body systems. The main effects are described in Table 13.

Stimulants of erythropoiesis

Stimulants of erythropoiesis (erythropoietin and similar substances) increase the number of red blood cells and, as a result of the availability of oxygen in the tissues.

They are substances that are used to improve aerobic performance, mostly used in endurance sports such as athletics, cycling and cross-country skiing.

The most important adverse effects can be checked out in Table 14.

Central Nervous System Stimulants

Stimulants of the central nervous system, such as amphetamines and cocaine but also ephedrine and its derivatives, are used to increase performance on the competition day. Amphetamines mask pain and fatigue. Cocaine increases tolerance to intense exertion.

Side effects of amphetamines, in addition to headache, insomnia and anxiety, are particularly important for athletes due to several cases of death in sport induced by heat stroke or by cardiac arrest[199].

Table 13. Adverse effects due to Anabolic-androgenic steroids (AAS)[198].

System	Adverse effect	Severity
Cardiovascular	Coronary/dyslipidemia atheromatous disease	++
	Cardiomyopathy	++
	Cardiac conduction anomalie	+
	Coagulation disorder	+
	Polycythemia	+
	Hypertension	+
Neuroendocrine (men)	Suppression of the Hypothalamic-pituitary-adrenal axis, hypogonadism after AAS	++
	Gynecomastia	+
	Prostatic hypertrophy	+/–
	Prostate cancer	+/–
Neuroendocrine (women)	Virilization	++
Neuropsychiatric	Mood disturbance: mania, hypomania, depression, aggression, violence	++
	AAS dependence	+
	Neuronal apoptosis,	++
	cognitive deficit	+/–
Hepatic	Inflammatory process and cholestasis	+
	Peliosis (uncommon)	+
	Neoplasm (uncommon)	+
Musculoskeletal	Premature epiphyseal closure (adolescent, uncommon)	+
	Tendon rupture	+
Renal	Secondary kidney failure to Rhabdomyolysis	+
	Focal segmental glomerulosclerosis	+
	Neoplasm (uncommon)	+/–
Immunological system	Immunosuppressive effects	+/–
Dermatological	Acne vulgaris	+
	Stretch marks	+

Severity valoration: ++, well recognized. Possibly causes great concern; +, well recognized but uncommon or less morblity; +/–, Possible risk, but relationship with AAS is not very known.

The use of cocaine has also caused several deaths associated with coronary occlusion in athletes who have exercised after its consumption[200].

Amphetamines and cocaine can cause abuse and dependence, and cocaine withdrawal syndrome[201].

Table 14. Adverse effects due to erythropoietin[198].

Adverse effect	Severity
Thromboembolic phenomenon	++
Higher cerebral stroke risk	++
Higher cardiovascular incidents risk	++
Hypertension	+
Higher dead risk	+++

Severity valoration: +, light to moderate; ++, potentially lethal; +++, very grave.

Table 15. Causes for accidental doping[203,204].

- Nutritional supplements adulterated with Anabolic-androgenic steroids (AAS)
- Food products with clenbuterol
- Natural products containing Anabolic-androgenic steroids (AAS)
- Nutritional supplements with stimulating
- Products coming from hormone treated animals
- Supplements with erythropoiesis stimulating products
- Cannabis
- Meant contamination by rival

Cannabis

In general, there are few acute health risks after cannabis use and are summarized in the involvement in traffic accidents due to a decrease of the psychic abilities such as decreased attention and the reaction capacity (especially if there is associated consumption of alcohol or other drugs). Other effects on health are chronic bronchopathy and an increased carcinogenic risk. There are also several neuropsychiatric disorders[202].

Accidental doping

The occasional consumption of products containing prohibited substances generally not declared in their composition, known as accidental doping, can be produced by the ways described in Table 15[203-205].

Nutritional supplements adulterated with EEA

The profusion of nutritional supplements contaminated with AAS called prohormones has been known for a long time and has been quantified in 15% of the analyzed products[178].

There is a huge offer of nutritional supplements that offer an increase in growth and muscle mass, where its advertising and labeling indicates that they have biological effects attributed to new ingredients and formulas derived from fantasy and unapproved names. Many of these products contain exogenous AAS (methandienone, stanozolol, oxandrolone and dehydrochloromethyltestosterone), in therapeutic or even supratherapeutic doses and are not declared on the label[178].

The content of these undeclared substances has its origin in unscrupulous cleaning in the packaging, impurities in the transport containers of suppliers of pro-hormones prime materials and, more frequently, in the intentional incorporation of these pro-hormones detected (especially nandrolone) that can cause detection in doping controls[206].

Foods with clenbuterol

Clenbuterol is a bronchodilator with anabolic effects and has caused known cases of doping, some due to consumption of contaminated beef, since in countries such as China and Mexico, it is known its frequent use in the fattening of cattle[207,208]. It is also known the case of beef contamination with zeranol[203].

Natural products containing AAS

There is information on the internet regarding anabolic steroids foods (spinach, quinoa, wild oats, eggs, celery, beans, herring, grapes, yogurt, green tea, coffee, broccoli, tomatoes, watermelon or garlic) and cases of natural anabolic substances (tribulus terrestris, magnesium, HMB, ornithine, lysine, arginine, etc.), of which there is no study that supports such property.

There is one specific case of a meat product, musk deer meat extract, which contains huge amounts of AAS and was unknown to athletes, which provoked endogenous adverse analytical findings in five feminine soccer players in the World Cup of Germany 2011[209].

Nutritional supplements with stimulants

They are products that contain ephedrine and analogues, sibutramine or metylhexaneamine, which are presented primarily as fat burners or mood enhancers and which can produce adverse analytical findings (AAF) in doping controls.

The risk of accidental doping with these supplements is caused by the labeling of such products with plant names, such as Ma Huang or Ephedra, rather than the names of the active ingredients (ephedrine, pseudoephedrine, metylephedrine, etc.)[206-210].

Animal products treated with hormones

In the European Union it is forbidden to use any hormonal product to increase growth in animal production, but in the USA it is legal to use five hormones (17 beta-estradiol, testosterone, progesterone, trembolone and zeranol) through small solid implants on the ears[211], which obviously can cause AAF in doping controls.

Supplements with erythropoiesis stimulants

Blood builders have been found recently, which can be translated as "blood builders", detected in products seized by anti-doping authorities or purchased over the internet containing erythropoietin or stabilizers of the inducible factor by hypoxia (HIF), and also cobalt (introduced on the prohibited substances list in 2016)[191], which only

indicated the presence of the substance on the label in 2 of the 19 products analyzed[204].

Cannabis

Besides the voluntary consumption of cannabis, generally smoked, there are three other forms of contact with this substance: passive inhalation, food products containing it and medical use.

Passive inhalation. The impregnation with cannabinoids does not require direct consumption, it is enough to inhale them in an environment where they can be found in the air they inhale. The problem for the athlete is that, contrary to what happens in judicial contact that establishes a limit below which is not considered punishable (50 g / L in screening and 15 g / L to confirm the presence of the substance)[212], in the doping control any witnessing of the substance in a doping control is considered AAF[191].

Food products made with cannabis. There is a way to prepare food with this substance. Marijuana teas, brownies with marijuana, commercialized products (chocolate, lollipops, gum, salt ...), hemp oil and hemp seed products, homemade foods (cookies, cakes, macaroni, etc.) are some of them[213].

Medical use of cannabis. In Spain the only medical preparation with tetrahydrocannabidol is the one marketed as Sativex (Almirall), whose only indication is spasticity due to multiple sclerosis without adequate response to other medications.

Intentional contamination by rival

Although this type of unintentional doping is rare and most likely to occur in high-level sport, we must be conscious that the claims of an increasing number of amateur / recreational athletes is increasingly ambitious. Therefore, it is not inappropriate to remark the doping that can provoke an athlete to an opponent by contaminating their food or drink.

There are a few cases that have been described. In the pre-Olympic classification of women's field hockey 2008 in Baku (Azerbaijan), there were two AAFs from the ecstasy family in two Spanish players who showed massive intoxication and were not sanctioned.

It has been said that the Argentine team provided water containing narcotics to Brazil in the match they played in the 90 World Cup.

In 2016 an alleged poisoning of a British tennis player in the Wimbledon tennis tournament was investigated, who remained in the intensive care unit for four days, and a Kyrgyz weightlifter reported that he was doped by a French rival in the Olympic Games of Rio de Janeiro.

Unnoticed doping

Unnoticed doping is understood as the use of a medicine containing prohibited substances unknowingly and without requesting authorization for therapeutic use.

It should be reminded that, with the exception of very few substances (basically heroin, cocaine and amphetamines), all substances included in the list of substances and methods prohibited by doping are medicines and some of them are very commonly used[191], as with beta-blockers, some bronchodilators, diuretics, corticoids, some stimulants and insulin, to name a few.

It is common for the athlete to use a medicine without thinking that it may contain doping substances, especially if it is prescribed by a doctor. It often happens that the athlete does not think that a medicine, especially if it is of common use, contains a product capable of causing an AAF in a doping control and is still more confident if it has been prescribed by a doctor.

On the other hand, except physicians specialized in physical education and sports medicine and some interested in sports, when it comes to prescribing, they do not contemplate if the drug in question may contain doping substances.

For this reason, the athlete must check that the medicine does not contain substances capable of causing an AAF, either calling attention on this aspect to the prescribing physician, consulting the physician if the drug can have these types of substances, or by going to a physician expert in the theme.

According to the 2015 Annual Report of the Spanish Agency for the Protection of Health in Sport (AEPSAD) of 2015[214], a total of 179 Therapeutic Use Exemptions (TUE) were requested, the most requested substances being glucocorticosteroids (59), (29), methylphenidate (27), insulin (15), diuretics (9), beta-blockers (8), growth hormone (8) and testosterone

The most frequent pathological causes of TUE were: asthma (41), attention deficit hyperactivity disorder (ADHD) (31), diabetes (15), high blood pressure (10), musculoskeletal trauma injuries (8), growth hormone deficiency (8), allergies by ingestion (7), contact allergies (5), bacterial or viral diseases (5), neuropathic pain syndrome (5) and hypogonadism (4).

The sports that most ATUs requested were the cycling with 26 (ratio ATU request / license number: 2,918), athletics with 21 (ratio: 3 377), soccer with 13 (ratio: 69,982), basketball with 11 (ratio: 32,350), Gymnastics with 19 (ratio: 3,884), triathlon with 8 (ratio: 3,717), handball with 8 (ratio: 11,590), rowing with 8 (ratio: 1,566), motoring with 7 (ratio: 2,153) (Ratio: 1,316) and water sports with 5 (ratio: 12,729).

It is very important to know, and it is discussed in the following section, that drugs containing dopant substances can be used, but in order to avoid being sanctioned, the therapeutic authorization procedure should be followed[215].

Therapeutic Use Exemptions

Although the Medical Committee of the International Olympic Committee, after banning various medicines in common use in the 1980s, proposed to put in place a mechanism that would allow the use of some medicines included in the list of prohibited substances for the treatment of various pathologies for Barcelona Olympic Games of 1992[216], it wasn't until the creation of the World Anti-Doping Agency that an authorization system was established to grant use of a substance or prohibited method that its called authorization for therapeutic use (TUE)[215].

Table 16. Criteria for authorization concession for therapeutic use[215].

- Forbidden substance or method must be needed for treating chronic or acute pathology, in fact that if athlete does not get this administration, his health would be damaged
- Being improbable that substance's therapeutic use was going to increase performance, more than athlete's health recuperation after the treatment
- When there is not any other alternative than the substance or method
- Using the substance or method cannot be a consequence for having used any other forbidden substance or method before

An authorization for therapeutic use (TUE) is an authorization granted, to use a prohibited substance or method[217], by the competent authority through a Committee of Therapeutic Authorizations (CTUE) following a procedure established by law[215].

The conditions for obtaining a TUE are based on the athlete being able to demonstrate by balance of probabilities that each and every one of the following conditions that are described in Table 16 are fulfilled and comply with the whole established procedure.

Procedure for granting an TUE[215]

The athlete must submit an TUE request, at least 30 days before the next competition, in his national anti-doping organization (in Spain, the AEPSAD), in his international federation and / or in an organization responsible for major events, through an official TUE application form.

The form shall be accompanied by a qualified medical certificate confirming the need for the athlete to use, for therapeutic reasons, the prohibited substance or forbidden method and a complete medical record, which will include the documentation issued by the physician who made the initial diagnosis (If possible) and the results of all tests, laboratory analysis and a photo record of the pathological process.

The athlete must keep a complete copy of the application form of the TUE and all documents and information provided in the application.

The CTUE can ask the athlete or his physician for information, test results or studies for additional images or other information and the costs are taken care by the athlete.

The CTUE will normally decide within 21 days by written notice and will notify the World Anti-Doping Agency (WADA) and other anti-doping organizations through the ADAMS system or other WADA-approved system.

The granting of an TUE shall include the dosage, frequency, route and duration of administration allowed by the CTUE in respect of the prohibited substance or prohibited method concerned, and the clinical circumstances and any condition with respect to the ATU as well as the exact duration of the TUE. If the athlete needs to continue making use of the prohibited substance or prohibited method after the expiration date, he must submit a new application.

If the TUE is denied, the CTUE will explain why it was rejected.

TUEs are perceived in some sporting context as a problem with regard to anti-doping policy, with the argument that authorization, in some cases, allows the use of substances legally but for doping purposes[218]. Although Sport Medicine understands that adequate treatment should be provided to all people suffering from a pathology, it is also in favor of establishing measures to avoid possible fraudulent use of drugs authorized by TUE.

The athlete's Injury

Conceptually it is understood by sport injury as any physical incidence that causes pain or incapacity in a person who performs sport, but from an epidemiological point of view it is that pathological situation osteo-musculo-articular that, as a consequence of the sport practice, causes a pain or an invalidating situation that prevents at least one day of training.

Sports injuries are classified as acute and chronic.

Acute injury occurs suddenly and can be direct or extrinsic if it is produced by an external agent as a blow, or indirect or intrinsic, in which there is no impact, or external aggression, and the injury originates at a distance from the contact zone. Examples of these lesions are the ankle sprain and the ischio-sural musculature injury, respectively[219].

Chronic injury, or injury due to overload, is the most typical in sport and is produced by the continuous repetition of a sporting gesture. It is also called sports technopathy or atlopathy when it is given by a very specific and exclusive gesture of a sports activity for example the so-called "jumper's knee", which causes proximal patellar tendinopathy in jump sports. These injuries are favored by predisposing biomechanical factors, by factors triggered by excessive intensity of physical work or by lack of adequate rest. These lesions are very complicated to treat, especially if you do not act on the predisposing and triggering factors.

The most serious chronic injury is the fracture of overload or stress. It is a micro-fracture in a bone zone under heavy load as in metatarsals, although it may appear in other bones such as the fibula, tibia and femur in runners, pelvis and ribs in golfers or patella in jumpers. If it is not diagnosed early it is long lasting and in some cases, it will require surgery.

Lesions are also classified according to the affected structure (bony, muscular, tendinous, cartilaginous, ligamentous and affecting the skin and subcutaneous tissue) and the degree of involvement of the injured structure (contusion, distension, partial rupture slight degree or degree I, partial rupture or degree II and complete rupture

or degree III). Finally, depending on the degree of functional involvement, the lesions are classified as competent and incompetent. In the firsts, the degree of injury does not affect the function even if there is discomfort, as in some mild and moderate contusions or distentions. In these lesions, there is no histological damage, the biomechanical structures are stable and generally, one can follow the sport practice. In incompetent injuries, histological damage occurs and sports activity cannot be maintained. Bone, muscle, and tendon lesions belong to this group.

When the histological lesion is partial, the incompetence may be insignificant and even in certain sports in which that anatomical zone is not important for the sporting gesture, it can allow the development of the activity with some help (acromio-clavicular subluxation in a bike driver) But if the histological damage is important, it is impossible to resume physical activity. Therefore, the distal rupture of an extensor of the fingers of the hand is an incompetent total injury, but in a tennis player and in the non-dominant hand, it does not incapacitate him to wield the racket, because in that case the movement is exclusively of flexion and even sometimes, in the rupture of the tendon there is no pain, not so when it is a bony avulsion[220].

The affected body area depends on the type of sport. In sports that are performed in standing position (running, jumping, team sport), the most affected area is the lower limb, whereas in throwing sports is the upper limb.

In marching and running the tendon and bony elements of maximal overload are affected (Achilles tendon, fascia lata, posterior tibial tendon, stress fractures in metatarsals, tibia, fibula or femur), whereas in the jumping the extensor of the knee is affected, jumper's knee as chronic tendinopathy of the proximal area of the patellar tendon[221].

In the pitches, the supraspinatus tendon is frequently affected, in sports with racket, injury of the insertion of the supine muscles[222] is frequent, although also the insertion of the pronators is affected, as in golf[223].

From an epidemiological point of view, running, which is possibly the sport with more recreational type athletes, has an incidence of injuries in new runners of about 30 injuries / 1,000 h of running[6,224], and can affect up to 30% of new runners in 1 year[225].

In soccer, muscular injuries are the most frequent (31% of the total) and represent 27% of the days of sports loss of all injuries. 60% of muscle injuries are relapses, demonstrating the difficulty of treating them correctly to avoid relapse[226].

Treatment

The objective of the treatment of the sports injury is to obtain the restitution "*ad integrum*" and in the shortest possible time.

Functional treatments should be performed to avoid the consequences of traditional immobilization treatments such as reflex muscle atrophy, loss of proprioception, joint stiffness or even regional decalcification[226].

In the case of the competent injury, the joint can be mobilized immediately and following the basic criteria for treatment of acute injuries: cryotherapy, compression and elevation. If there is a histological lesion (partial tear of a ligament) to the previous treatment a functional dressing is added. If there is a significant histological lesion and anatomical incompetence, the criterion of functionality, always present, must be adapted to the treatment most appropriate to the preservation of the affected tissues[227].

Adequate treatment requires that, from the overall diagnosis and control of the doctor, there is coordination with all the professionals who attend and direct the athlete (rehabilitator, physiotherapist, sports readapter, trainer and coach).

Readaptation to sport

It is the last element in the process of treating and healing a sports injury. Once the injury is overcome, specific training is necessary to return to sports activity at the level prior to the injury, which will not only serve to re-perform the exercise adequately but also to prevent similar injuries or relapses[228,229].

Prevention of sports injury

Prevention is the best way to avoid sport injuries, but the search for performance along with the multifactorial origin of injuries makes it difficult to identify predisposing and triggering risk factors and, once identified, to promote prevention strategies.

Van Mechelen in 1992[230] described the "sequential model for injury prevention" and the different models and patterns of prevention described since then[231-234] are based on their principles, with the identification of the injury in the context of their sport, analysis of the factors that predispose and trigger the injury, establishment of protocols of action and analysis of the results of the treatment performed.

There are three levels of prevention: primary, secondary and tertiary.

Primary prevention

These are measures designed to prevent initial sports injuries, which must take into account personal, environmental, especially temperature, humidity and wind factors, and materials used in sport, such as footwear, clothing and protections, which requires a medical-sports examination prior to the beginning of the sport.

Secondary prevention

These are measures designed to prevent a recurrence of an injury after it has occurred. In addition to a correct diagnosis and treatment of the previous injury, sports activity should not be restarted until a progressive sports rehabilitation program has been performed until the physical and proprioceptive conditions pre-injury have been restored.

The so-called "psychological wound" will in some cases require extra help in order to forget the problem and lose the fear of restar-

Table 17. Agreement evidences about the practice in sports/exercise.

	Evidence	Evidence level
Pre-participation evaluation	Pre-participation and monitoring medical are needed for medical risks prevention, for improving performance and health	A
	The pre-participation screening in people under 35 years old must include family and personal history, anamnesis, physical exploration and resting electrocardiogram	B
	The pre-participation screening in people older than 35 years old must include family and personal history, anamnesis, physical exploration and resting electrocardiogram and stress test with electrocardiogram	B
Health benefits	Practicing exercise regularly and reducing sedentary habits are needed for adult's health	A
Health risks	Sudden sport death (SSD) in people younger than 35 years old are usually due to congenital causes	A
	SSD in people older than 35 years old are usually due to acquired illness in coronary arteries	A
	SSD is a spontaneous death that happens during or one hour after practicing exercise/sports	B
	SSD appears frequently, and represents a double value than those without physical activity practice	B
Training	Training induced adaptations are reverted depending on the time after stopping practicing	A
	There is a variability in exercise induced individual responses	A
	Cardiorespiratory and resistance training are the most recommended to improve physical fitness and health	A
	Aerobic exercise must be practiced ≥ 5 times a week	A
	Aerobic exercise intensity must be prescribed as ≥ 5 times a week for moderate exercise, or ≥ 3 times a week for high intensity exercise, or a combination of both ≥ 3-5 times a week	A
	30-60 min/day (150 min/week) of moderate aerobic exercise, or 20-60 min/day (75 min/week) of high intensity exercise, or a combination of both for most of adult people	A
	Practicing resistance training regularly, with an aim of getting wide muscular groups involved in a rhythmic and continuous way is recommendable	A
	<20 min/day (<150min/week) of exercise practice may have some benefits in those people previously sedentary	B
	Aerobic exercise may be practiced either moderate or high intensity by most of adults	B
	Light-moderate intensity aerobic exercise may be beneficial for sedentary people	B
	Scientific societies exercise programs may be efficient for improving or maintaining short-term exercise	B
	Moderate and fun exercise can improve exercise acceptation and adherence	B
	A gradual progression is recommended for exercise volume adjusting training time, frequency and intensity till goals are reached	B
Treatment	SSD treatment in athletes needs a quick access to a semi-automatic defibrillator	B
	SSD treatment in athletes needs knowledge in cardiopulmonary resuscitation	C
Nutrition	Nutritional valuation is needed to know consumed nutrients related to practiced activity, for detecting deficiency and to prescribe supplements or ergogenic aids	A
	Supplements prescription and/or medical treatment must be done individually depending on conditions and needs of exercise effort	A
	Individual diet must be used for introducing healthy habits in alimentation, developing a nutritional plan for improving performance and doping prevention.	A

ting activity or competition, something that can happen not only in serious injuries but in any injury.

In children, special care must be taken as they do not yet have developed the central neurological reflexes and do not control well the situations of tiredness and pain. In their case, they should be directed by specialized personnel[235-237].

Tertiary prevention

It is much more specific and is one that tries to avoid the appearance of an injury in zones of maximum biomechanical stress in athletes of certain level. In this case in the functional assessment should be studied in a specialized manner.

Consensus evidence

Shown in Table 17.

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