Special Aerobic Exercises

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CONTENTS

OSTEOPOROSIS

1.1. DISEASE CHARACTERISTICS

Osteoporosis is a systemic illness characterized by bone mass loss (osteopenia) and micro-architectural deterioration which increases fracture risk (Compston, 1992). It is a disease which can affect any person. Progressive bone mineral loss starts generally around 25 years of age both in men and women. With the passing of time all people experience a reduction in bone mass, although osteoporosis is especially frequent from 70 years of age on. Postmenopausal women (Alastair, 1998) are a group especially affected by this disease. However, there exist some risk factors which predispose its development.

A) Genetic factors: Race (Higher predisposition in white race), sex (women, especially after menopause), genetic diseases (Marfan disease, Imperfect Osteogenesis, etc), factors depending on certain hormones and metabolism (hipertiroidism, diabetes, estrogen deficiency, etc) and people with family antecedents.
B) Enviromental factors: Some illnesses (Rheumathoid arthritis, hyperparatiroidism, chronic hepatic diseases, deficient intestinal absorption etc), postmenopausal women, elderly people, inadequate

diet and deficiency of calcium, protein and vitamin D. Certain kinds of medication such as cortisone, antiepileptics or thyroid hormones, excess of alcohol, tobacco, coffee or drugs (glucocorticoids, tiroxine, caffeine, anticonvulsants etc)

Although we are inclined to think of osteoporosis as a modern disease, particularly in view of its apparently greater prevalence in the more prosperous societies of the world, the contribution of bone fragility to fractures in the elderly has been known for at least 200 years. It is difficult to say when the term "osteoporosis" was first used in the modern sense, but it was certainly employed by pathologists in the mid-nineteenth century and was clearly distinguished from osteomalacia by Pommer almost exactly 100 years ago. At the clinical level the crush fracture syndrome was still being confused with osteomalacia in the 1930's, but by the end of that decade Albright had definitively identified it with osteoporosis, which he defined as "too little calcified bone," and his teaching has been amply confirmed (Nordin, 2009).

Osteoporosis is a major public health threat for an estimated 44 million Americans or 55 percent of the people 50 years of age and older. In the U.S. today, 10 million individuals are estimated to already have the disease and almost 34 million more are estimated to have low bone mass, placing them at increased risk for osteoporosis. While osteoporosis is often thought of as an older person's disease, it can strike at any age. Of the 10 million Americans estimated to have osteoporosis, eighty percent of those affected by osteoporosis are women. Osteoporosis and osteoporotic fractures are more frequent in white people, followed by the asiatic. Black and hispanic people are the ones who present a lower incidence.

We can state that there are four kinds of osteoporosis:

A) *Hormonal osteoporosis:* In some patients with osteoporosis the underlying cause is a hormonal imbalance caused by an increase in the secretion of antianabolic hormones (Crannney, 2006).
B) *Osteoporosis caused by inactivity.* When the body becomes atrophied for lack of exercise bones are no exception (except skull bones). This can happen at any age (Cancela & Ayán, 2007; Karlsson et al., 2008).

C) *Postmenopausal and senile Osteoporosis*. These two kinds of generalized osteoporosis are studied in combination because they share many characteristics. The difference between them is somehow arbitrary since, when women develop osteoporosis between menopause and 65 years of age, osteoporosis is called postmenopausal, whereas when men and women develop the same process from 65 years of age on it is called senile (Cooper et al., 1992; Hui et al., 1990; Ahlborg et al., 2003).

D) *Reflex* Sympathetic Dystrophy (RSD) (Sudek's Atrophy) It is a localized post-traumatic or subsequent to immobilization osteoporosis accompanied with pain and edema in the affected zone and hypercalciura. This injury is reversible and it is evident the influence of a negative sympathetic nervous factor (Van der Laan & Goris, 1997).

In order to deal with osteoporosis prevention is the best policy. It is especially important during the first stages of life, that is, during the person's growing process and development, childhood and adolescence (Del Rio & Roig, 2001). Exercising is an indispensable factor, among others, to reach the maximum peak of bone mass before loss starts at more advanced ages. Aerobic exercise during old age must be performed cautiously because it is during this stage of life when complications are more likely to appear due to the pathology's onset itself and the decrease in neuromotor abilities.

1.2. Aerobic Exercise and Osteoporosis

Aerobic exercise has a direct effect on bone tissue through the tensions provoked by the bones during the performance of the activity. This load provokes a reorientation of the trabecules to adapt their mass and their architecture to de main direction of the load (Del Rio & Roig, 2001). When load is absent the bone becomes atrophied (Bellver & Pujol, 1997), that is, a decrease or lack of load can be the cause for trabecule loss (Henderson, White, Eisman, 1998), whereas an increase of load provokes bone hypertrophy

(Bellver & Pujol, 1997). Various techniques and physical agents can offer important benefits to osteoporosis patients but especially physical exercise, because it has an osteogenic effect which is higher the younger the exerciser is (Honda et al., 2001; Robling et al., 2002). Consequently, it has a preventive effect both by providing a greater bone mass peak during youth and by preventing mineral mass loss later in life. Numerous clinical essays and reviews related directly and positively the effect of exercise with bone mass at any age. (Bailey et al., 1999).

Matsumoto et al. (1997) studied total bone mass density (BMD) and different metabolic markers in three groups of sports people in the modality of judo, athletics (long distance runners) and swimming. They did not find differences in total bone mass density of the body between long distance runners and swimmers, however they found that total bone mass density of the body for both sexes was greater in judokas than in the other two groups. They concluded that these differences were caused by the demands of the specific sport and they were reflected in the rest of metabolic indexes.

Bellver & Pujol (1997) found that the highest percentage of frequency of decreased bone mass was observed in swimmers, artistic gymnasts and athletes.

Courteix et al. (1998) compared female swimmers and gymnasts of a control group, all of them in prepuberal age. BMD between swimmers and control group did not present any difference; however, gymnasts presented higher bone mass density than swimmers and control group. They concluded that physical activity is positive only if the practised sport produces enough bone tension in a medium to long term program, like gymnastics and unlike swimming.

According to this evidence we can conclude that aerobic exercise influences bone tissue and it is indirectly related with less falls and fractures which are the most dramatic result of this illness. Consequently, constant aerobic activity adequated to every patient's capability must be an inexcusable part of osteoporosis treatment (Whalen et al., 1988), however, not every kind of aerobic exercise has the same effect on bone tissue loss because, as many studies indicate, aerobic exercise in a non-gravity environment does not produce the desired effects on the bone.

1.3. Mechanism of Action

There exist evidence of beneficial effects of aerobic exercise on osteoporosis patients. Krall et al. (1994) indicate that postmenopausal women who walked more than a mile daily lost less bone density than those who walked shorter distances, which shows how positive aerobic exercise can be in the treatment and prevention of osteoporosis. Lewis & Modlesky (1998), point out that performing repetitive exercise with a light load (walking, cycling) can have a possitive effect on bone mass if intensity is high. Xhardez, (1995) highlights the preventive function of aerobic exercises (cycling, swimming, etc) as a basic kinesiotherapic treatmet of primitive osteoporosis. Apart from the aforementioned benefits, physical exercise provokes an improvement in blood circulation, new coronary vessels stimulation, muscular tissue reaffirmation and tone and increased tension on the bone. Calcification and calcium absorption are increased. Bones are strengthend and risk of fracture is reduced. Circulating adrenalin levels (stress hormone) decrease and endorfin and other cerebral substances increase. Emotional tension is reduced and mood is improved, resulting in a greater emotional and social well-being sensation. Therefore, we recommend antigravitatory aerobic exercises (which involve moving the body weight against gravity) as an effective therapy to prevent osteoporosis and fractures (Birge & Daisky, 1989), especially for elderly people and postmenopausal women (Santora, 1987; Prince et al., 1991; Agre et al., 1988), because it helps to keep bones and muscles active and avoid the weakness typical of the ageing process.

1.4. Physical Exercise Prescription in Osteoporosis

The best kind of aerobic exercise to strengthen bones is resistance training (Dupple et al., 1997), that is, exercise which forces the patient to work against gravity, such as walking, climbing up slopes, running, climbing stairs, play tennis, dancing etc. The optimal situation is performing 30-60 minutes of exercise four times a week. Before starting any regular exercise program is convenient to consult a doctor, especially if the patient is over 40 or has got any associate pathology. Professionals then will prescribe the aerobic exercise program which best adapts to the patient's requirements in order to enable him/her to strengthen his/her muscles safely and correct bad posture habits. Exercise prescription must be oriented to the patient's needs and state of health. If the aim is to prevent osteoporosis, aerobic exercise programs must include weight-bearing activities such as walking, running or jogging (Lewis & Modlesky, 1998). It is recommendable to combine these activities with weight-lifting exercises, because this activity is related with higher increases of bone mass density (Barbado, 2001). If the patient has a high risk of osteoporosis or fractures, weight-bearing activities are contraindicated. In these cases we recommend swimming, hydrogymnastics and static bicycle (Xhardez, 1995). Physical exercise for osteoporosis patients must always be progressive and adapted to the cardiovascular state of the patient, never surpassing an established threshold (Andreoli et al., 2001).

Chapter 2

RHEUMATOID ARTHRITIS

2.1. DISEASE CHARACTERISTICS

Rheumatoid arthritis (RA) is a systemic autoimmune disorder characterized by a chronic inflammation of the joints which produces progressive destruction and different degrees of deformity and functional disability often progressing to destroy cartilage, bones, tendons and ligaments of the joints (Harris et al., 2005; Smolen et al., 2007).

The first convincing description of rheumatoid arthritis is found in French medical literature in 1800, in a document written by doctor Landré, who reports the illness indicating its higher frequency in the female sex and its characteristics, and describing it as primitive asthenic gout (Landre, 2001). However it is probable that the disease is much older than this (Short, 1974; Aceves-Avila et al., 2001). The term rheumatoid arthritis was first used in 1859 by Sir Alfred Garrod, who distinguished the disease from gout. However, this term also included polyarticular osteoarthritis and, up until relatively recently, a number of seronegative arthritides, such as psoriatic arthritis. It was Sir Archibald Garrod, Sir Alfred's son, who distinguished rheumatoid arthritis from osteoarthritis in 1907.

Arthritis and other rheumatic diseases are leading causes of disability in the US and are predicted to affect 60 million people by 2020 (CDC, 1994), RA is present in 0.5–1% of the general population, twice as often in women, and the disease's age of onset is mainly between 45 and 65 years. The American College of Rheumatology (formerly American Rheumatism Association [ARA]) has suggested diagnostic criteria for RA (Arnett et al., 1988). The disease course varies and prediction of the prognosis is difficult in any particular case. In the long run, a reduced function, difficulties in activities of daily living (ADL), and a negative psychosocial impact are often seen.

The treatment of RA focuses on decreasing inflammatory activity and symptoms, limiting joint destruction and disability, and improving health related quality of life. It includes a rich variety of medication, surgery, and rehabilitation. Despite earlier fear of aggravation of symptoms, increased disease activity, and joint destruction, there is now scientific support that various forms of exercise are both safe and beneficial (Minor, 1996). Exercise has become an important part of rehabilitation during the last decades. A number of studies of various quality have been carried out to investigate the effects of aerobic exercise in RA, reflecting the benefits of it on this group of patients.

2.2. Aerobic Exercise and Rheumatoid Arthritis

The RA patients' fear of aggravating their illness, get injured or feel more pain usually disencourages them to practise any kind of physical exercise even aerobic exercise. Recent studies (Stenstrom & Minor, 2003) have proved that the aim of aerobic exercise in this group of patients must be to complement pharmacologic therapy in order to control the disease evolution and reduce inactivity. Sedentarism provokes muscle atrophy, flexibility reduction and important aerobic capacity loss. These factors can be controlled and modified through specific exercise programs (Pool & Axford, 2001), therefore, exercise can be part of the RA patients' daily life. Minor et al. (1989) carried out a piece of research with a group of 120 patients with rheumatoid arthritis or osteoarthritis who volunteered to be subjects for this study of aerobic versus non-aerobic exercise. The aerobic exercise program consisted of walking

(Experimental group 1), aerobic aquatics (Experimental group 2), whereas non-aerobic exercise program was based on range of motion (Control group). The obtained results showed that subjects tolerated adequately all the different kinds of aerobic exercise. The aquatics and walking exercise groups showed significant improvement over the control group in aerobic capacity, 50-foot walking time, depression, anxiety, and physical activity after the 12-week exercise program.

Van de Ende et al. (1998) carried out a systematic review to determine the effectiveness of dynamic exercise therapy in improving joint mobility, muscle strength, aerobic capacity and daily functioning in patients with rheumatoid arthritis (RA). They checked the Cochrane Controlled trials Register, MEDLINE, EMBASE and SCISEARCH databases up to May 1997 in order to study controlled trials on the effect of exercise therapy. The results suggest that dynamic exercise therapy is effective at increasing aerobic capacity and muscle strength. No detrimental effects on disease activity and pain were observed.

Westby et al. (2000) assessed the effects of a 12 month, weight bearing, aerobic exercise program on disease activity, physical function, and bone mineral density (BMD) in women with rheumatoid arthritis (RA) taking low dose prednisone. The results showed that subjects in the exercise group had a small but non-significant decrease in disease activity and statistically significant improvements in physical function ($p = 0.05$) and activity levels ($p = 0.05$). The authors concluded that women with RA taking low dose steroid therapy can safely participate in a dynamic, weight bearing exercise programs with positive effects on their physical function, activity and fitness levels, and BMD with no exacerbation of disease activity.

Gaudin et al. (2008) developed a review of the literature from 1964 to 2005 in order to analyze and determine the optimal program, frequency, target population and the best assessment tools for monitoring clinical, functional, and structural parameters during dynamic exercise therapy in patients with RA. The obtained results show that dynamic exercise programs improve aerobic capacity and muscle strength in patients with RA. Their effects on functional capacity are unclear, since many sources of bias influenced the study results.

These studies corroborate the hypothesis that aerobic exercise, by itself or combined, provokes an improvement in the RA patients' functional capability and enables them to perform daily life activities without experiencing any pain increase, disease advance or joint injuries. Nevertheless, future research must try to establish the guidelines and the most adequate kind of aerobic exercise depending on the illness evolution.

2.3. Mechanism of Action

It is widely known that Rheumatoid Arthritis induces in the patient several combined processes. Swelling, pain, reduction in the range of joint mobility and joint deformation provoke disability and impairment of a great number of daily functions which compromise to a higher or lower degree the patient's independence. On the other hand, when the first symptoms appear, the person starts a psychological assimilation of this new health deterioration state which causes him/her continuous stress due to the constant process of adaptation and superation he/she must face every day (Lindroth, 1994). Medical and scientific results (Stenstrom, 2003; Ekdahl & Broman, 1992; Harkcom et al., 1985) obtained during the last decades have shown that exercise in general and aerobic exercise in particular is one of the best forms to minimize pain and limitation caused by RA, and to alleviate other associated pathologies such as bone mass loss, joint damage, depression, anxiety or sleep disorders. Therefore, aerobic exercise programs prescribed by health and exercise professionals must be systematically included in RA treatment.

2.4. Physical Exercise Prescription in Rheumatoid Arthritis

Starting an aerobic exercise program may be a great challenge for the patients. Understanding the benefits of exercise for RA for these people will help health professionals to prescribe adequate and safe training programs especially designed to meet the patient's requirements and recommentations about how to handle the body's response to exercise and how to modify the exercise routine if it is necessary.

Current recommendations include aerobic exercise understood as a programmed activity which involves the rhythmic and repetitive movement of major muscle groups in the body for 45-60 minutes (Westby, et al., 2000) at a moderate intensity 3-5 times a week. The recommended time can be accumulated in 10-minute periods during the day or the week in order to obtain similar health benefits to those obtained of a continuous training session. This offers greater exercise planning flexibility and allows people who experience pain or fatigue to perform shorter sessions within their own personal tolerance range. Moderate intensity (60%-80%) is the safest and most efficacious effort level in aerobic exercise (Minor, et al., 1989). This means that the person who is exercising can talk normally (Speech test) does not become breathless or hot and is able continue the activity for a long time without feeling any discomfort. Any fluctuation in the disease symptoms must be taken into account, such as longer periods of joint stiffness or pain. In these periods, the patient may need more rest and less exercise. (Stenstrom & Minor MA, 2003).

Prior to any aerobic exercise program the patient must take into account the following (ACSM, 1990):

1. Long term and short term real targets should be fixed in order to become motivated when these targets are reached.
2. Exercise should be performed in company (friends, family).
3. A record of exercises and progression must be kept daily.
4. Problems and impediments which stand in the way of exercising should be identified and avoided.
5. The chosen activities must be convenient, motivating and entertaining.

Safe aerobic exercise activities include walking, aquatic exercising, cycling or exercising in static bycicles, treadmills or elliptical walking machines. Daily activities such as mowing the lawn, raking leaves, playing

golf or walking the dog are also aerobic exercises if they are performed at normal intensity (Finckh, 2003).

SYSTEMIC LUPUS ERYTHEMATOSUS

3.1. DISEASE CHARACTERISTICS

Systemic lupus erythematosus (SLE or lupus) is an often-severe autoimmune rheumatic disease of unclear aetiology and most commonly diagnosed in women in their childbearing years. Although it was first described in the XIIIth century by physician Rogerius (who thought that facial lesions caused by the disease looked like wolf bites), the systemic form was firmly established by doctors Osler and Jadassohn, respectively in the XXth century (Mallavarapu, 2007). Lupus is known as an autoimmune disease because a person's immune system attacks the body's own tissues. In lupus, the signs and symptoms of the disease can be attributed to damage caused directly by autoantibodies, the deposition of immune complexes (the combination of antigen and autoantibody), or cell-mediated immune mechanisms. The course of the disease is unpredictable, with periods of illness (called flares) alternating with remissions. Common initial and chronic complaints are fever, malaise, joint pains, myalgias, fatigue and photosensitivity among others, but the most common symptom are dermatological manifestations such as red scaly patches on the skin or the presence of the classic malar rash (or butterfly rash). Although a gold standard or single conceptual paradigm does not exist for the diagnosis of SLE, the

American College of Rheumatology established eleven criteria, which, despite being originally meant to "facilitate formal communication" have become de facto diagnostic criteria. Based on these criteria it has been estimated that SLE affects 241 in 100.000 people in the United States (Ward, 2004). Current treatment includes nonsteroidal anti-inflammatory drugs, although mild or remittent disease can sometimes be safely left untreated.

Despite the fact that SLE patients can present various clinical conditions such as fatigue, pulmonary disease, heart disease, and peripheral neuropathy, they may benefit from exercise, as observed in other populations, suffering from similar chronic pathologies. Because of that, the prescription of aerobic exercise in SLE can be part of their multidisciplinary rehabilitation treatment.

3.2. Aerobic Exercise and Lupus

Reduced exercise capacity is common in SLE patients, which has been attributed to cardiac, pulmonary, parenchymal and vascular lesions. In fact, recent studies have found that SLE patients show some clear signs of reduced exercise capacity (see Table 1), such as a lower anaerobic threshold, maximum minute ventilation and maximum heart rate (HR), reduced resting lung function measures, especially forced vital capacity, and a generally diminished aerobic capacity (VO2max). In this regard, it is important to note that aerobic exercise has been successfully prescribed as a component of therapy for SLE' as the follow-up studies show (Ayán & Martín, 2007). One study compared the effects of an 8-week home-based aerobic cycling programme in sixteen patients with a non-aerobic stretching programme in a control group, and reported no differences in SLE activity, hematocrit, hours of sleep or depression measures. On the other hand, aerobic capacity improved by 19% and there was a significant difference in fatigue in the treated group, whose members indicated that they had more energy and an improved sense of well-being after the exercise programme. A similar 12-week programme where thirty-seven patients were randomly assigned to stationary cycling or to a control group, showed that exercisers improved fatigue and depression measures, as well as exercise tolerance, but not significantly. Because of that, it was concluded that although it is safe, unsupervised home exercise programmes may benefit few patients. This safety of exercising and the variability of its effects were confirmed afterwards in a pilot study, where five patients participated in an aerobic programme and received an individual exercise prescription based on their initial level of fitness. They were instructed to exercise to 70-80% of their maximum heart rate, and met for 50 minutes, three times per week for 2 months. After that, patients continued to exercise in the supervised setting for one month and then unsupervised at home for 6 months, combining aerobic exercise with muscular resistance training. Another five patients underwent an exercise programme limited to arm and leg movement. They met in the same way as the other group, but after 2 months, muscle strengthening was added. At the end of the program the patients showed some improvement in fatigue, functional status, exercise capacity and muscle strength, while the adherence standard was met by 80% of the patients. However, once the intervention ended only two of them continued to exercise after a year. This finding shows that although exercise must be beneficial and improve the quality of life, it also needs to include motivating factors to maintain patients' participation. In this regard, it is important to note that home-based programmes are not always as efficient as supervised ones, as the study carried out by Tench et al. (2003) shows. Thirty-three patients were asked to exercise at home at least three times a week for between 30 and 50 minutes for 12 weeks, the main exercise being walking, with cycling and swimming also available. Thirty-two control patients were asked to listen to a relaxation audiotape. After the training programme, 49% of the exercise patients and 28% of the relaxation patients rated themselves as "much" or "very much" better, and there was a trend for the subsidiary outcome of fatigue to improve, while there was a significant increase in exercise duration (18%), and a decrease in pain. On the other hand, some patients abandoned both groups, although there was no flare in disease activity or serious adverse events. Aerobic capacity did not improve, owing perhaps to the mild exercise intensity (only 90 minutes of exercise per week at a maximum 60% of VO2max) or poor compliance with therapy. After three months' follow-up, fatigue improvements were not maintained, possibly because only eight patients continued to exercise.

Finally, Carvalho et al. (2005) designed a 12 week aerobic training programme, where the patients met for 60 minutes 3 times a week. The main exercise was walking at a heart rate corresponding to their ventilatory anaerobic threshold. Among the fifty patients assigned to the training group, forty-one completed the cardiovascular training programme, and showed a significant improvement in aerobic capacity, exercise tolerance, O_2 pulse, and pulmonary ventilatory capacity, which proves that physical condition can be trained in SLE patients. Moreover, functional capacity, fatigue, depression and quality of life also improved. Thus, cardiovascular training is well tolerated and its effects on physical condition can be transferred to the activities of the patients' daily life.

In spite of all this, it must be taken into account that all the studies that have been mentioned here have included patients with low to moderate disease activity, so the safety of exercise for patients with high disease activity and its effects need to be addressed in future investigations.

3.3. Mechanism of Action

There are a number of reasons for explaining the beneficial effects of aerobic exercise in SLE patients. For instance, it is widely known that the oxygen uptake needed for the instrumental activities of daily living ranges from 10.5 to 17.5 ml/kg/min. The lowest VO2max value reported in SLE patients is 18.1 ml/kg/min, which is very close to this interval. This finding suggests that in patients with mild SLE, the magnitude of aerobic insufficiency may limit the capacity to engage in occupational and recreational tasks and even affect the ability to sustain normal daily activities for more than minimal periods of time. Because of that, it can be stated that if aerobic training improves exercise capacity, SLE patients will obtain a better quality of life. Furthermore, there are a number of related symptoms, such as obesity, depression, sleep disturbances or osteoporosis which affect the patients' well-being and that can be ameliorated by means of exercising too. To this, it must be added that maintaining a good baseline level of physical fitness can help SLE patients to minimize loss of function when lupus flares, to decrease stress on inflamed joints, and to lessen fatigue levels. Lastly, aerobic exercise can reduce the impact of heart and lung problems in lupus as well as limit the risk of injury, such as those due to falls resulting from weakness.

Table 1. Mean VO2max values in SLE patients

Researchers	**Number of patients**	**(VO2max) ml/kg/minute**
Carvalho et al.	50	24.64
Keyser et al.	18	19.2
Forte et al.	13	1098
Tench et al.	31	21.5
Tench et al.	93	23.2
Sakauchi et al.	21	810.7

3.4. Physical Exercise Prescription in SLE

According to Clarke-Jenssen et al. (2005) walking at an intensity of 70% of the SLE patient's maximum heart rate, three times a week, starting from 25 minutes per session during the first week to 40 minutes from third week onwards, can be an easy way to achieve some improvements in aerobic capacity and fatigue, with no aggravation of the health state. Other activities, such as swimming or stationary cycling at intensity between 70–80% of the maximum heart rate, for 30–50 minutes, three times a week, can be just as effective.

However, it is important to note that sustained physical training effects depend on the patient's determination to continue exercising once the formal supervised programme is over. Because of that, motivation towards exercising must be the key to a successful aerobic training intervention.

Lastly, it must be pointed out that, although they are usually safe, exercise programmes can have some risks. Some studies have shown significant differences between SLE patients and controls in heart rate at rest, and in blood pressure response to standing. Lower adrenaline and plasma noradrenaline levels have also been found. These parameters must be taken the effects of disparate alternative therapies such as dietetic modifications, hypnosis and physiotherapy, obtaining contradictory results (Sueiro et al., 2008). Today, it is considered that one of the most efficacious options is to follow a multidisciplinarian rehabilitation treatment which combines strategies for the self-control of the illness (cognitive educational therapy), exercising and different relaxation techniques to reduce the stress.

4.2. Fibromyalgia and Aerobic Exercise

There is a large amount of research these days on the effects of physical exercise applied to FM patients which aims at reducing the intensity of some symptoms and the recovery of the patient's physical condition. According to the excellent review carried out by Mannerkorpi (2003) exercise programs for FM patients can be divided in three main groups:

Walking

The different existing studies which have proposed walking as a physical rehabilitation therapy have obtained disparate, but mainly positive results. Some of them have achieved an increase in the aerobic capacity, a reduction in the number of tender points and a greater feeling of well-being. Others, despite not achieving the first point, have been able to show an improvement in the patient's quality of life, which is reflected in a greater autonomy, efficacy and personal satisfaction. It must be pointed out the fact that combining an educational cognitive therapy with the walking program has given better results than the walking program alone.

Pedaling

The first studies on the effects of aerobic exercise on FM were developed using cycloergometers, where the patients pedaled following an established protocol. This kind of exercise has generally been reported as positive when used as a rehabilitation therapy. It reduces the number of tender points, raises the pain threshold, improves the patients' well-being and increases their aerobic capacity. However, it must be taken into account that the existence of trigger points in the gluteal region could prevent pedaling at an adequate intensity. It has been confirmed that when two exercise programs only differ in intensity, those patients who follow the most intense one get a greater improvement in their physical condition than those who pedal at a lower intensity. However, they showed more post-exercise discomfort, which in some cases forced them to abandon the program. This is the reason why low to medium intensity aerobic exercise is preferable in this case, since it will produce virtually the same effects than high intensity work allowing patients to adhere to the exercise program more easily.

Water Exercise

Although water exercise is one of the best ways for FM patients to develop their physical condition, it is not usually proposed as an aerobic training method. Several studies indicate that water temperature should be around 34°C in order to reduce pain and muscular strain, enable the patients to relax and become aware of their own body. In addition to this, a shallow swimming pool is indispensable to carry out training programs which include aqua-fitness or aqua-aerobic exercises adapted to the patients' characteristics, and it is especially necessary for those people who cannot swim in order to be able to take advantage of the benefits of water. The expected effects will be, apart from an improvement in physical condition, a reduction of important symptoms such as pain, fatigue or anxiety, and a greater feeling of well-being. In this regard, a safe modality of aerobic conditioning in water has been proposed: deep water running, where the patient performs a running movement in the pool while wearing a floating belt. This modality of aerobic training has been shown to be as effective as land based exercises (Assis et al., 2006).

Since FM can cause slighter degrees of disability, some of patients are able to perform more demanding aerobic activities such as "Aerobic". In this respect, Schachter et al., (2003) compared the effects of 1 long exercise bout versus 2 short exercise bouts per training day (fractionation) on physical function, signs and symptoms of fibromyalgia, and exercise adherence. Both groups progressed in total daily training duration from 10 to 30 minutes, 3 to 5 times a week, for 16 weeks. The main training segment music tempo was progressed from 126 beats per minute (bmp) for the first third of the training segment to 132 bpm for the middle third of the training segment and then to 144 bpm for the final third of the training segment. At the end of the program, no differences were seen between both training groups. Thus, fractionation of "Aerobic" training sessions provided no advantage in terms of exercise adherence, improvements in fibromyalgia symptoms or physical function. Although FM patients experienced some improvement in their fitness level, the high attrition rates and the adherence problems observed in the study proves that "Aerobic" might not be the most advisable aerobic training modality for people suffering from FM.

4.3. Mechanism of Action

The reasons why aerobic exercise may be beneficial for people who suffer from FM are many. First, it has been proved that different training programs have reduced the magnitude of the pain which is characteristic of this syndrome. This is probably due to the fact that when exercise is moderately intense and well tolerated by the patient, the aforementioned secretions may cause a state of hypoalgesia as well as a stimulation of the opioid system which induces a feeling of euphoria and well-being. In addition to this, it is known that physical exercise has an effect on the short wave of sleep, decreasing its latency and therefore positively influencing the feeling of well-being. Some authors point out that the benefits of exercise on FM are mainly based on the fact that local muscular circulation is increased and susceptibility to microtrauma is lowered, inducing a reduction in pain and an improvement in glucose metabolism (which is presumably upset in this kind of patients).

This means an improvement in muscle relaxation due to the increase of ATP levels and it would explain why those disciplines which involve the lower limbs (cycling, walking) have proved to reduce muscular pain in the gluteal region. On top of this, we must add that this kind of patients not only obtain physical benefits, but also feel emotionally rewarded when health professionals who are aware of the impact of this illness in their lives try to prescribe them some kind of physical therapy to ease their situation, making them feel emotionally and psychologically better (Valencia et al., 2008).

Table 2. Basic guidelines for prescribing cycling in FM patients

Volume	Intensity	Frequency	Observations
25 minutes	50% VO_2 Max	2-3 Days /Week	Similar intensity to 65% of Max H.R.
30-60 minutes	150 beats per minute	3 Days/Week	Good initial physical condition.

4.4. Aerobic Exercise Prescription for FM

One of the recommended aerobic exercises for FM is pedaling, especially with modern static bicycles which allow a complete control of the training sessions. An advisable protocol of action for this kind of exercise includes a pedaling session at 25% of maximum HR for 12 minutes approximately 2-3 times a week. Every week HR level can be increased in 5% and the duration of the exercise can be extended to 14 minutes. After a month and a half approximately, HR can reach 60% and maintain that level until the patient is able to perform a total of 25-30 minutes of aerobic exercise. From that point on, it is not advisable to increase the volume of work or combine different exercises, since a high intensity effort could bring about the negative effects already mentioned. In the case of unfit and seriously affected patients two weekly sessions are recommended including two blocks of 6-minute pedaling exercises. If the training frequency is high, it will be possible to perform two 25-minute blocks after three months. The intensity of the exercise must allow the patients to talk comfortably while they are exercising or slightly sweating. This instructions could equally be applied to walking.

An example of a training schedule is shown in Table 2, which shows bicycle protocols used in different studies involving people affected by FM.

When establishing an aerobic training protocol, it must be taken into account that most research on fybromialgia and physical exercise has reported a sometimes excessively high percentage of patients who abandon the program (Busch et al., 2007). This indicates that not every patient tolerates physical exercise in the same way and that most of them give up due to fatigue and pain. Researchers speculate that programming low intensity exercise in order to avoid fatigue leads to an insufficient stimulation and production of adrenocoricotropic hormones, beta-endorphines, prolactin and serotonin, therefore, the hypoalgesic effect of exercise does not occur. In order to avoid this kind of problems the best course of action is to individualize as much as possible the training program and encourage group sessions where the patients can openly express all those positive and negative sensations that, in their opinion, may be related to aerobic exercise.

OBESITY

5.1. CHARACTERISTICS OF THE ILLNESS

Obesity is a rapidly growing epidemic worldwide which increases the risk of morbidity and mortality (Thompson et al., 2007). It is estimated that between 60% to 65% of adults in the United States are overweight (Jakicic, 2003).

Obesity is a symptom of overfeeding that may have some underlying emotional causes. It can be the consequence of a metabolic disorder as well. Genetic factors are also important, so obese parents have 80% of possibilities of having obese children. It is defined as an abnormal increase in the fat proportion in the body. Most of the excess of food, either if it is fats, carbohydrates or proteins is accumulated in the subcutaneous tissue and around the internal organs. Obesity is a risk factor in several deadly illnesses, including various types of cancer, diabetes and heart disease (Thibodeau & Patton, 2000).

A method used to diagnose obesity is the Body Mass Index (BMI).There are more precise methods to calculate body fat percentage, but they are too complex to be employed in primary health care.

BMI= weight (in Kg) / height^2 (in m)

Table 3. Weight classification

Classification	BMI (kg/m2)
Insufficient weight	< 18,5
Normoweight	18,5-24,9
Overweight type I	25-26,9
Overweight type II	27-29,9
Obesity type I	30-34,9
Obesity type II	35-39,9
Obesity type III (morbid)	40-49,9
Obesity type IV (extreme)	> 50

This method, accepted by the World Health Organization (WHO) has proved to show a good correlation with body mass especially in truly obese or highly overweight people.

The aim is to reduce fat mass and increase lean body mass, therefore, prescribing exercise for obese people will reduce risk factors of many chronic conditions including diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers, and arthritis. Of these conditions, diabetes may be most closely linked to obesity, and its prevalence appears to have increased as the prevalence of obesity increased" (Harris et al., 1998).

5.2. Aerobic Exercise and Obesity

Physical exercise is highly recommendable as a complement to diet for obese people, however, there is no clear consensus about the suitable duration and intensity of exercise to obtain positive benefits from physical activity. The center of Disease Control and Prevention and the American College of Sport Medicine recommend a minimum of 30 minutes of moderate intensity activity on most days of the week (150 min/week), however, the Institute of Medicine recommends a minimum of 60 min/day of exercise on most days of the week to control body weight. Jakicic et al. (2003) studied weight loss and cardiorespiratory fitness during 12 months (in women) with groups which worked at different intensities and durations. At the end of the study results showed that weight loss occurred both in the longer duration and higher intensity group and in the moderate intensity and moderate duration group. In addition to this, there was an improvement of cardiorespiratory fitness in all groups. According to the study results, the author advises to follow the ACSM recommendation of 150 min/week, especially at the beginning of the training program, and to increase gradually to the Institute of Medicine recommendation of 60min/day, according to the patients level progress.

Church et al. (2007) worked in a similar way (also with women) although they focused on the effect of different doses of exercise on cardiorespiratory fitness. They took as a starting point the ACSM recommendations of 150 min/ week to establish work groups. One group worked as control group, another at 50% (4 kcal/kg per week)of the ACSM recommended time, another one following the ACSM guidelines (8 kcal/kg per week) and one last group worked at 150% (12 kcal/kg per week) of those guidelines. Work intensity was maintained for all groups at 50% Vo2max, and the program was carried out during 6 months. One of the most salient findings was that the group with a smaller aerobic load showed an improvement in fitness compared to the control group. Besides, the 12 kcal group obtained a higher improvement in fitness than the 8 kcal group. This study did not report weight loss in any of the groups, although waist circumference decreased in all, which is important because excessive abdominal fat is related to an increase in insulin resistance risk, diabetes and metabolic syndrom.

Besides the lack of consensus as far as exercise recommendation is concerned, we must take into account the high incidence of obesity in children. As Goran et al. (1999) show in their work: "Although energy intake depends solely on dietary consumption, energy expenditure is dependent on several components, with the major modifiable aspect being physical activity. Thus, both dietary and physical activity patterns have been emphasized as appropriate interventions for the prevention of obesity. However, among children, a reduction in energy intake may compromise growth and essential energy acquisition. In addition, attempts to modify the eating patterns of children may exacerbate the risk of introducing eating disorders. Although it is clear that physical activity has beneficial effects on health, the optimal intensities, volumes and modalities are unclear, especially in children".

5.3. Mechanism of Action

Exercise is an important component in interventions in overweight and obese people because it achieves an improvement in body weight in a short time, combined with an adequate diet, and is one of the best predictors for long term weight loss.

Although many variables play an important role in it, weight is mainly determined by caloric balance. This means the difference between consumed calories (energy equivalent that food intake provides) and energy expenditure (the energy equivalent of resting metabolic index, the thermic effect of food and the performed physical activity).

The effect of exercise, increasing energy expenditure, results more effective if it is accompanied by a balanced diet, if the aim is to reduce body weight (Jakicic & Otto, 2005). One kilogram of fat equals 7.700 kcal of energy approximately. Long duration and moderate intensity exercises (aerobic exercise) encourages fat burning. When caloric balance is negative induced by exercise, weight loss is mainly fat.

Several studies have researched if physical exercise is able to increase appetite, provoking a higher energy intake. It seems that in obese patients practising exercise can induce higher food intake, thus consuming more calories, although this larger amount of energy does not jeopardize weight loss in most cases because it is not larger than the amount of energy consumed during exercise. Therefore, the global effect is positive (Woo & Sunyer, 1982).

It must be taken into account the fact that physical activity means a reduction in energy consumption derived from other activities when prescribing aerobic exercise to elderly people or to people who are very unfit.

A greater amount of induced fat loss was observed in men than in women (Westerterp & Goram, 1997), especially abdominal fat, both cutaneous and perivisceral, possibly due to the faster lipolithic response of fat in this locations and the higher release of catecholamines derived from exercise. It is important to note that abdominal fat, especially perivisceral fat is closely related to arteriosclerosis and cardiovascular disease (Irwin et al., 2003). Apart from the effect of physical exercise on weight loss, positive effects on the rest of obesity related pathologies must be taken into account as well (Fenster et al., 2002).

5.4. Physical Exercise Prescription in Obesity

The optimal program for weight loss involves a combination of moderate caloric restrictions with regular aerobic exercise, always avoiding any kind of nutritional deficiency.

When designing a weight loss training program, a balance between intensity and duration of the exercise must be kept in order to provoke a hight total caloric expenditure (300-500 kcal per session and 1000-2000 kcal per week, in adults). Obese people have a higher risk of suffering orthopedic injuries, that is the reason why intensity should be kept under the recommended intensity for aerobic capacity improvement.

Having in mind the points mentioned above, we have followed the review carried out by Kelly et al. (2005) who include 11 studies where aerobic exercise programs have been employed. The following guidelines are based on the values used by said studies:

Frequency: 3-5 times a week
Intensity: 45-75% Vo2max
Duration: 20 -60 minutes per session.

HYPERTENSION

6.1. DISEASE CHARACTERISTICS

The World Health Organization defines high blood pressure as "a chronic rise in the systolic pressure, the diastolic pressure or both over the established normal limit for every age group or sex." Hypertension is the most common human disease (ACSM, 2000) and it affects over 50 million Americans (Bacon et al., 2004). It is regarded as an important health problem since it represents one of the main risk factors for cardiovascular disease in the developed countries (Hagberg et al., 2000).

Hypertension is classified into two groups: primary or essential hypertension and secondary hypertension. 95% of hypertension cases belong to the first group whose main cause is unknown, although populations who risk suffering from it are obese people, people with a high concentration of sodium in plasma or people with hypercholesterolemia. Secondary hypertension is related to several renal, pulmonary, endocrine and vascular diseases.

Table 4. Classification of hypertension.

Classification of hypertension	SBP (mmHg)	DBP (mmHg)
Normal	<120	<80
Prehypertension	120-139	80-89
Stage 1 hypertension	140-159	90-99
Stage 2 hypertension	≥160	≥100

Source WHO 2009.

It was in 1983 when the WHO recommended a non-pharmacologic approach to treat hypertension. Since then there has been plenty of evidence that physical exercise plays an important role in the disease treatment (Wallance, 2003). According to this organization, hypertension is associated to a systolic pressure over 140 and a diastolic pressure over 90. The values corresponding to pre-hypertension are found in people who are at risk of suffering the illness and must be controlled in order to normalize their blood pressure.

People who suffer from light to moderate hypertension may feel no symptom whatsoever, therefore their daily activities will not be impaired, but the physical limitations will show up when target organs are affected by the disease increasing the risk of suffering cardiovascular pathologies (coronary disease, ictus, heart failure, etc).

Therefore, the aim of hypertension treatment is to minimize the possible repercussion of the illness on target organs. We must take into account here that hypertension involves a wide range of different problems due to the several variables that may have an effect on it (sex, weight, sodium intake, stress level, alcohol consumption, tobacco, etc)

6.2. Aerobic Exercise and Hypertension

The modification of the patient's lifestyle is the first action in hypertension treatment (Baster & Baster-Brooks, 2005), including regular physical activity which not only has a beneficial effect on hypertension but also reduces the risk of suffering any cardiovascular event.

Aerobic exercise has proved to be an effective non-pharmacologic method to reduce blood pressure, both by itself alone and combined with other courses of action (Manfredini et al., 2008). There is concluding evidence that this kind of exercise reduces resting blood pressure (Sharman & Stowasser, 2009) even at a low intensity (50% VO2max). Halbert et al. (1997) reflects in his meta-analysis that aerobic activities such as walking, jogging or cycling produce an average reduction of 10.7 and 7.6 mmHg in the values of resting blood pressure for both Systolic Blood Pressure and Diastolic Blood Pressure in patients with mild to sever hypertension. It is assumed that all aerobic activities provide the patients with the same healthy effects regardless of the type of activity: jogging, walking, cycling and swimming, which is frequently recommended. Cox (2006) studied two groups of women aged 50-70. One group walked and the other swam and after a 6-month training period the group that had been walking reduced their blood pressure, whereas the group that had been swimming experienced an increase in it. The reasons for this rise are unknown but facial immersion, hydrostatic pressure, breath holding or water temperature may be playing a role in it. Thus, adaptation to the medium seems necessary. More research is needed in order to establish more accurate recommendations.

Another aspect that must be taken into account is that exercise produces a different effect on people depending on their age, sex and race. Therefore, middle-aged people reduce their systolic blood pressure to a higher degree than the young or the elderly (the number of people of every group of age in the sample is also an important aspect to have in mind) (Hagberg et al., 2000). It must be noted that elderly people with mild hypertension may experience an intensification of the effects of hypertensive medication (as well as a reduction in blood pressure) due to endurance training.

Regarding sex differences, according to Hagberg et al. (2000) hypertension is equally frequent in men than in women and regular exercise benefits both sexes (Sharman, 2009) although women reduce more their Systolic Blood Pressure values.

As far as race is concerned, we can establish that blood pressure decreased in Afroamerican men and black adult women although the training proved to be more effective (regarding systolic values) for Asian and Pacific Island patients than for Caucasians (Manfredini et al., 2008).

6.3. Mechanism of Action

How physical activity positively affects blood pressure is not known. The mechanisms by which aerobic physical exercise benefits people who suffer from high blood pressure are related to multiple factors including a reduction in adrenaline and noradrenalin secretion at rest and during sub-maximum effort, a release of endorphin which is produced during physical exercise and which induces a state of metal relaxation and physical well being which in turn may attenuate or eliminate the stressing factors which raise blood pressure (Chintanadilok & Lowenthal, 2002).

During physical exercise there is also a decrease in insulin secretion which causes a reduction in tubular reabsorption of sodium and a subsequent fall in blood pressure. It is worth mentioning that weight loss due to exercise also reduces blood pressure (GAFS, 2006) although the most important factors to be taken into account are mainly related to the sympathetic nervous system and the improvement of the endothelial function (Manfredini et al., 2008).

Sympathetic Nervous System

Physical training improves blood pressure reaction to stress and induces modifications in the cardiovascular system. After a training session a period of hypotension follows which is associated to a lesser peripheral resistance of the blood vessels. Said resistance decreases due to the reduction in sympathetic activity which is subsequent to the physical effort, being more noticeable in patients with essential hypertension (O'Sullivan & Bell, 2000). This lower blood pressure may be maintained in time if training becomes a regular practice.

Endothelial Function

Several studies have shown that endothelial dysfunction is typical of hypertension. The endothelium lining of the blood vessels keeps a normal vascular tone, increasing blood fluidity and regulating vessel growth. Exercise produces a higher shear stress (increased blood flow in the vessel wall) and stimulates the production of nitric oxide by the endothelium (Zanesco & Antunes, 2007) Nitric oxide plays an important role in the regulation of vascular tone favoring vessel dilatation.

6.4. Physical Exercise Prescription in Hypertension

There are variations between the recommendations of different authors, although as Hagberg et al. (2000) indicates, the results show that moderate to low intensity endurance training is as efficacious as higher intensity activity. This is an important aspect to point out regarding public health, since low to moderate aerobic exercise programs are easier to perform by hypertension patients.

Intensity

As we already mentioned, low intensity effort has beneficial effects on blood pressure, and that is the reason why most recommendations are oriented towards low intensity. Manfredini et al. (2008) states in his work that the exercise intensity recommended by authors was 50% VO2max, since it was obtained the same or even better results than with high intensity training. According to Wallance (2003), a training session at 50% VO2max for 45 minutes produced better results than the same training session at 70% VO2max. In addition to this, the American College of Sport Medicine (Blaster & Blaster-Brooks, 2005) recommends aerobic exercise at intensity between 50-65% VO2max.

Volume

There is not much consistency as far as this parameter is concerned. The general recommendation ranges from 30' to 60' of aerobic exercise. Evidence exists that an activity carried out for only 20' obtained a reduction in blood pressure. Although the relation between exercise duration and blood pressure reduction is not conclusive it can be suggested that longer duration exercise may be more effective than shorter duration exercise (Wallance, 2003). It is also important to note that interval exercising (4 10-minute fast pace walking sessions) was as effective as 40' in a continuous way (Manfredini et al., 2008). ACSM recommends starting by short duration sessions during the first (3-4) training weeks in order to achieve proper body conditioning. In a later stage time will be extended according to every person's adaptation to exercise.

Frequency

The minimum frequency for a sedentary person to be able to obtain an reduction in blood pressure is 3 days (Wallance, 2003) or approximately 60-90 minutes a week. Most authors recommend a frequency between 3-5 days a week. Higher frequencies do not decrease blood pressure significantly. We should also take into that if the patient wants to lose weight, we should increase frequency in order to optimize weight loss work.

Table 5. Basic guidelines for aerobic exercise in hypertension.

Intensity	Volume	Frecuency	Observationes
40-60% MHR	30-60 minutes	3-5 days/week	Possible side effects of hypertension medication (if taken) must be taken into account.

DIABETES MELLITUS

7.1. DISEASE CHARACTERISTICS

There are 23.6 million people in the United States, or 8% of the population, who suffer from diabetes. The total prevalence of diabetes increased 13.5% from 2005-2007. Only 24% of diabetes is undiagnosed, down from 30% in 2005 and from 50% ten years ago. (ADA, 2009).

This illness was already known by the ancient Greek doctors who called it "diabetes" because this word in Greek means "to go through" and refers to the fast passage of water through the patient's body to be excreted as urine very shortly after it has been consumed. Almost 1,500 years after being defined the disease was named "diabetes mellitus" because "mellitus" in Greek means "honey" and describes the "sugary" tendency of diabetic urine. It was not until 1921 that insulin was discovered, a hormone obtained from animal pancreatic tissue which was directly injected into the patient's body until synthetic human insulin became available, being the common treatment nowadays. (Thibodeau & Patton, 2000).

The main feature of diabetes mellitus is lack of insulin which has negative consequences on the metabolism of carbohydrates, fats and proteins (Guyton & Hall, 2001).

This problems with insulin (either the lack or the resistance to it) make it impossible for the diabetic people's cells (except brain cells) to absorb glucose and to use it efficiently as fuel, creating a rise in blood glucose level (hyperglycemia) which is one of the most important symptoms of this illness. Glucose is filtered, as a general rule, from the blood by the renal tubes, however, when blood glucose level increases, renal tubes are unable to absorb more glucose and as a result, the exceeding amount ends up in the urine (glycosuria). The body needs more water in order to be able to handle this larger volume of sugar and therefore urine production is more abundant (polyuria). Water loss through urination generates body dehydration which becomes worse when the high blood glucose levels increase the osmotic concentration of the blood and take water from the cells. Feeling excessively and progressively thirsty (polydipsia) and drinking large amounts of liquid are also some of the main symptoms of this disease. In addition to this, diabetic patients are intensely and continuously hungry due to the inability of the cells to absorb the necessary glucose to burn as a source of energy (Thibodeau & Patton, 2000).

On the other hand, the metabolic change that involves using fats and proteins as a source of energy causes fatigue and weight loss. The metabolism of fats in diabetes increases the release of ketoacids (ketonic bodies) into the plasma. The increase in organic acid decreases blood pH inducing diabetic ketoacidosis. This can provoke a diabetic coma or even death in a very short period of time if the patient is not treated immediately with large doses of insulin. Extreme acidosis only happens in very serious cases of diabetes which are not controlled.

Another consequence of fat metabolism is that it causes higher lipid levels in the blood (hyperlipidemia) and higher cardiovascular disease risk.

There are two kinds of diabetes: Diabetes Mellitus Type 1 and Diabetes Mellitus Type 2

Diabetes Mellitus Type 1 (DM1)

It is also called insulin-dependent diabetes because the patients need to inject insulin into their body in order to be able to control blood glucose levels. This kind represents 10% of the total number of diabetic people. It is also known as young diabetes as it is found in people under 30 years of age. Being diagnosed as having this illness has an influence on functional changes, sexual and psychological maturity, physical development and social adaptation (Sideraviciute et al., 2006).

This kind of diabetes is characterized by a total lack of insulin which cannot be produced by the body due to the auto-immune destruction of ∃-cells in the Langerhans islets (located in the pancreas) which are the ones responsible for the insulin secretion.

The best treatment for DM1 is based on three fundamental principles: insulin therapy, diet and exercise. Patients must learn to control and estimate the amount of carbohydrates that they consume in order to be able to regulate blood glucose level by adjusting their insulin doses (De Angelis et al., 2006).

Diabetes Mellitus Type 2 (DM2)

Also called non insulin-dependent diabetes mellitus is the most frequent form of the disease, representing 90% of the total cases. In general, it starts gradually at 40 and often during the 50-60 decade, being known as middle-age diabetes. In susceptible people who are overweight incidence increases with age. In this kind of diabetes ∃-cells still produce insulin but it is insufficient to meet the patient's needs. Besides, the loss of insulin receptors in the cellular surface membrane reduces the efficiency of glucose absorption, which is known as resistance to insulin.

Non insulin-dependent patients do not need hormone injections to control the disease. In these cases, hyperglycemia usually responds positively to changes in lifestyle, but if this is not enough to reduce glucose blood levels in DM2, oral hypoglycemic drugs can be prescribed in order to stimulate ∃-cells activity to produce more insulin by improving the effectiveness of insulin receptors in the cell.

Genes and ethnic background are fundamental in DM2. Family history is a key factor in overweight and sedentary people. American natives have increased risk to suffer from DM2 and Hispanic and Afro-American have more chances than Caucasians to develop this kind of diabetes.

DM2 symptoms are more subtle and less noticeable than those of DM1. The American Diabetes Association (ADA) estimates that over 7 million Americans have diabetes without knowing it. This represents a risk because if hyperglycemia is not controlled it can cause numerous problems in many areas of the body. Reduced blood flow due to the accumulation of fat materials in the blood vessels (atherosclerosis) is one of the most serious complications.

The disease causes diverse problems such as heart attack, stroke and poor blood circulation in the limbs which produces a tingling sensation and numbness in the feet and in grave cases, gangrene. Retinal alterations (diabetic retinopathy) can cause blindness to some patients who have been fighting against the illness for decades. Renal disease is also a frequent diabetic complication. Almost all authors agree that a scrupulous control of blood glucose levels is the most important step that diabetics can take in order to minimize long term complications caused by the illness (Thibodeau & Patton 2000).

In both types of diabetes, diet and exercise play an important role since patients should lose weight in order to be able to reverse insulin resistance (Guyton & Hall, 2001).

7.2. Aerobic Exercise and Diabetes

DM1 incidence is lower than that of DM2 ant it is normally diagnosed in the first stages of life, which means that the patient must get used to living with the insulin treatment and with the daily control of the illness symptoms for life. Due to these complications, it is important to develop and apply strategies which allow DM1 patients to participate safely and comfortably in regular physical activities. All sports both performed with a recreational or competitive purpose are suitable for these people as long as blood glucose level is controlled (De Angelis, 2006).

Diabetes Mellitus Type 1

When dealing with the problem of how much exercise should be encouraged in diabetic patients it is important to take into account the characteristics that this activity must have in order to prevent hyperglycemia, since a correct blood glucose level control enables the reduction of the disease complications and the patient's health improvement.

Aerobic exercise and resistance training have been studied and compared in order to establish which activity offers the best results to this kind of population. After 12 weeks of training both groups showed and improvement in the reduction of NPH insulin dose and a slight increase in cardio-respiratory resistance, although only the aerobic exercise group showed a decrease in the waist-hip ratio and waist circumference. There were no positive results for lipid profile of fasting food sugar either before or after the exercise program. The effect of aerobic exercise on lipid profile is a controversial matter because the results of different studies show disparate data. This fact could be related to the short duration of the training programs carried out in these studies or maybe the effect of exercise on lipid profile is only noticeable in people who have a previously altered profile before the exercise and not in those whose profile is normal. (Ramalho et al., 2008).

Most studies which have assessed the effect of physical exercise on DM1 control are based on aerobic exercise, and the results have been disparate, since metabolic control improvements have been obtained only in some cases (Kavookjian et al., 2007; Ramalho et al., 2006). 11 DM1 patients showed beneficial effects in glycated hemoglobin after a 12-week training period of aerobic exercise and resistance training. Similar results were obtained in another study of DM1 teenagers after 12 weeks of vigorous games and recreational activities. However, not every study obtained the same beneficial results despite the fact that the number of training weeks was the same in all of them (Ramalho et al., 2006).

It has been argued that one of the possible reasons for the lack of improvement in glycated hemoglobin is the fact that these studies have been carried out in a very short period of time and that it may be necessary to perform a regular exercise program with a longer span duration (a year) in order to be able to observe different results. (Ramalho et al., 2006). Another possibility is that although insulin needs decrease with physical exercise glicemic control does not improve because patients consume more carbohydrates in order to prevent exercise-associated hypoglycemia (Kavookjian et al., 2007).

Several authors (Sideraviciute et al., 2006; Komatsu et al., 2005) have reported a higher BMI value for DM1 teenagers compared to healthy adolescents. Fat mass percentage is also higher in DM1 patients although after 14 weeks of swimming training this percentage was reduced significantly (Sideraviciute et al., 2006). After the exercise program participants experienced an improvement in their aerobic capacity, which is normally lower than that of healthy people (Sideraviciute et al., 2006; Komatsu et al., 2005). This is an important fact to take into account when prescribing exercise to these populations.

Diabetes Mellitus Type 2

DM2 patients benefit from aerobic activity because insulin sensitivity improvement and blood glucose control produce positive changes in body composition. Despite these benefits and the encouragement of aerobic exercise by doctors, less than 30% of diabetics, which is less than the general population, participate in aerobic activities, thus not reaching the recommended minimum. This inactivity is related to the difficulties that diabetic patients have in sport practice due to being overweight and suffering from foot ailments (Plotnikoff, et al., 2008).

Kavookjian et al., (2007) in their review of numerous studies on interventions on diabetic people found that exercise could reduce Hb A1c levels in such a way that it should also reduce the risks of the illness complications. High intensity exercise obtained better results in the reduction of these levels. Cardiovascular risk is also reduced through the effect that exercise has on blood pressure, body mass index and lipid profile. They pointed out that those programs which combine resistance training and aerobic exercise can also reduce abdominal and visceral fat and obesity. This combination has shown to improve significantly insulin sensitivity when compared with aerobic exercise alone. They also emphasize the fact that the interventions on DM2 populations lasted for short periods of time, therefore, it would be necessary to carry out longer interventions in order to observe the obtained results and the practice adherence.

7.3. Mechanism of Action

In DM1 patients physical exercise along with blood glucose control reduce the thickness of the basal membrane of the muscle capillary, the record of arterial pulse volume, and increase lean body mass and effort capacity.

One of the main benefits of physical exercise is the improvement of glucose tolerance due to the increase in insulin sensitivity. When insulin receptors affinity is increased a lower amount of insulin is needed to maintain correct blood glucose levels. This higher sensitivity enables glucose to enter the muscle cells efficiently, improving glucose homeostasis and reducing medication requirements. Insulin sensitivity seems to be related to capillary growth in the muscles after repetitive exercise, which provokes muscle hypertrophy and higher glucose metabolism. These adaptations result in lower needs of basal and posprandial insulin in DM patients. In young DM1 patients a reduction in insulin requirements was observed, in some cases up to 9%, which meant obvious social benefits for them due to their participation in sports.

Diabetic people who are physically fit have also a high insulin sensitivity which can be acute (as a result of faster muscular glucose replacement) or chronic (it indicates an increase in the total amount of metabolically active muscle) and which enables glucose to enter the cells more efficiently during exercise. It is important to note that the increase in sensitivity provided by exercise (acute effect) starts to decrease after 1 or 2 inactive days and it is lost a few days later.

Regular physical activity provokes beneficial physiological changes in DM2 patients including lower resting and Sub-Max heart rate, higher expulsion volume and cardiac consumption, improved oxygen extraction and lower blood pressure both at rest and during effort. In addition to this, abdominal fat is reduced, weight is better controlled and obesity is less likely to appear.

Another benefit is lower cardiovascular risk. The increase in aerobic capacity in DM2 patients is related to a less atherogenic lipid profile. Most studies, although not all of them, have found that after physical training DM2 patients show desirable changes in triglyceride levels, total cholesterol levels and HDL cholesterol/total cholesterol ratio. Regular physical activity also reduces blood pressure in people who suffer from DM2. The high level of insulin produces hypertrophy of the tunica media of the blood vessel's wall's muscle layer. This hypertrophy produces chronic hypertension. Exercise can reduce blood pressure by lowering insulin levels and reversing the wall's hypertrophy (GAFS, 2006).

Endothelial dysfunction is related to arteriosclerosis (Kavookjian et al., 2007), since it plays an important role in keeping the blood's fluidity, vascular tone and permeability. Endothelial dysfunction has been reported in both DM1 and DM2, where blood glucose level is associated to higher oxidative stress. Increased blood flow through the muscles during exercise provokes a higher stress on vascular walls, which results in higher nitric acid release and subsequent vascular dilatation.

Lastly, it is important to point out that psychological benefits such as stress reduction can result in better blood glucose level control, since stress can be a negative factor in this respect, which in turn improves the patient's quality of life.

7.4. Physical Exercise Prescription in Diabetes

Diabetes Mellitus Type 1

People with this type of diabetes must be very careful with their blood glucose control in order to avoid hyperglycemia induced by a wrong adjustment between insulin dose and physical exercise.

Rabasa-Lhoret, et al. (2001), show that habitual use of insulin prior to exercise (at any intensity) is associated to a higher risk of suffering a hyperglycemia episode. They propose:

- A 50% reduction of ultra-fast prepandrial insulin dose for 60-minute-long aerobic exercise performed at 25% of VO2max.
- A 50-75% reduction for 30 to 60 minutes long exercises performed at 50% of VO2max.
- A 75% for 40-minute long exercises at 75% of VO2max.

During long duration and low intensity exercise it is recommended to consume carbohydrates (10-15 g every 30 minutes) during or after the sport practice in order to prevent hypoglycemia if there has not been a reduction in the insulin dose.

According to the American College of Sport Medicine recommendations, the ideal aerobic program for DM1 is as follows:

Duration: 40 minutes.
Intensity: 40-85% VO2mác or 60-90% MHR (the first weeks intensity will be 60-70% and it will increase progressively depending on the patient's adaptation to exercise)
Frecuency: 3-5 times per week.

Diabetes Mellitus Type 2

The American Collage of Sport Medicine endorses exercise as a treatment method for people with type 2 diabetes and currently recommends expending a minimum cumulative total of 1000 kcal/week of energy from aerobic activities. The American Diabetes Association has similar recommendations for at least 150 min per week of moderate intensity aerobic physical activity and/or 90 min per week of vigorous aerobic exercise. However, it is necessary to improve the strategies, looking for the most effective methods to increase adherence ratio. (Gordon et al., 2009).

According to Sigal et al. (2004) recommendations, DM2 patients should stick to this aerobic training depending on the target they want to achieve.

To *improve glycemic control* and reduce risk of cardiovascular disease:

- Duration: 150 min/week or, 90 min/week
- Intensity: moderate aerobic exercise 40-60% Vo2max -50-70%MHR or vigorous aerobic exercise >60% Vo2max- >70% del MHR, respectively.
- Frequency: 3 days a week at least, trying not to spend more than two consecutive days without exercising.

To *reduce risk of cardiovascular disease:*

- Duration: 4 hours/week
- Intensity: vigorous aerobic (>60% Vo2max- >70% del MHR) combined with resistance exercise

For long-term *maintenance of major weight loss:*

- Duration: 7h/week.
- Intensity: moderate or vigorous aerobic physical activity.

Chapter 8

CARDIOVASCULAR DISEASE

8.1. DISEASE CHARACTERISTICS

Cardiovascular diseases (CVD) are those which affect the heart and blood vessels. They can be classified into various groups:

- Coronary heart disease: Diseases which affect the blood vessels which irrigate the cardiac muscle (myocardium).
- Cerebrovascular disease: Diseases which affect the blood vessels which irrigate the brain.
- Peripheral arteriopathies: Diseases which affect the blood vessels which irrigate higher and lower limbs.
- Rheumatic cardiopathy: Injuries of the myocardium and cardiac valves due to rheumatic fever, an illness caused by streptoccocus bacteria.
- Congenital cardiopathies: Marlformations or physical anomalies of the heart present from birth.
- Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE): Blood clots in the veins of the legs (thrombuses) which may become dislodged from their site of formation (embolus) and travel to the arterial blood supply of the lungs (embolism).

The American Heart Association points out that enormous progress has currently been made in the fight against cardiovascular diseases since, during the 1990's, they were the first cause of mortality in the United States. Nowadays,about 71 million American adults suffer from one or more different cardiovascular diseases. Every year in the United States cardiovascular diseases are top on the list of the gravest health problems in the country, Coronary Heart Disease being the first cause of death among them.

The cost of cardiovascular diseases and stroke in the United States in 2009 is estimated to be $475.3 billion, according to the American Heart Association and the National Heart, Lung, and Blood Institute (NHLBI). This figure includes both direct and indirect costs. Direct costs include the cost of physicians and other professionals, hospital and nursing home services, the cost of medications, home health care and other medical durables. Indirect costs include lost productivity that results from illness and death. This is only the economic cost. The true cost in human terms of suffering and lost lives is incalculable.

However, we must point out that, in spite of these data, scientific studies show that almost all cardiovascular disease patients or people susceptible to suffer from these illnesses can use aerobic exercise as an invaluable tool to recover health (Hoekstra et al., 2008), especially if they also follow an adequate diet and give up smoking.

8.2. Aerobic Exercise and Cardiovascular Disease

Lack of exercise and sedentary life are risk factors which accentuate the possibility of developing cardiovascular diseases. Aerobic activity during free time or at work is associated to a reduction of 30% in the frequency and mortality of cardiovascular diseases.This involves an inversely proportional relationship: the more aerobic physical activity, the less incidence of cardiovascular episodes. It is important to note that aerobic exercise is beneficial for both sexes and all age groups, as long as it is regularly practiced regardless of the age at which the patient starts exercising. This indicates that it is never too late to obtain its benefits.

Olson, et al. (2006) carried out a piece of research with the aim to examine the effects of 1 year of resistance training (RT) on vascular structure and function in overweight but otherwise healthy eumenorrheic women. They included 30 student women (15 control, 15 RT) overweight (BMI > 25 kg x m(-2)) aged 24-44 yr, who were studied before and after a 1-yr RT intervention. Vascular structure and function were assessed via noninvasive ultrasound imaging of the carotid and brachial arteries, respectively. Body composition, blood pressure, fasting blood lipids and glucose were also measured. The results showed that the RT group experienced a significant mean improvement in one-repetition maximum bench press following 1 yr of RT ($P < 0.05$). There was also a significant increase in lean body mass in the RT group compared to the control group ($P = 0.04$). There were no training-associated changes in blood pressure, fasting blood lipids, glucose, or insulin levels. Although there was no change in carotid artery intimamedia thickness, peak flow-mediated dilation significantly improved in the RT group ($P < 0.05$). The principal significant finding in this study was the initial demonstration that RT alone can improve brachial artery endothelial function in overweight eumenorrheic women, and therefore resistance training reduces the possiblity of suffering from cardiovascular disease.

Murphy et al. (2006) examined the effects of 45 minutes self-paced walking, 2 d. wk(-1) on aerobic fitness, blood pressure (BP), body composition, lipids and C-Reactive Protein (CRP) in previously sedentary civil servants. Age sample group consisted of 37 subjects (24 women) aged 41.5 +/- 9.3 years who were randomly assigned to either two 45-minute walks per week group (walking group) or no training group (control group). Aerobic fitness, body composition, blood pressure (BP), CRP and lipoprotein variables were measured at baseline and following 8 weeks. Step counts were measured at baseline and during weeks 4 and 8 of the intervention. Compared to the control group, the walking group showed a significant reduction in systolic BP and maintained body fat levels ($P < 0.05$). There were no changes in other risk factors. Subjects took significantly more steps on the days when prescribed walking was performed (9303 +/- 2665) compared to rest days (5803 +/- 2749; $P < 0.001$). These findings suggest that walking twice per week for 45 minutes at approximately 62% HRmax, improves activity levels, reduces systolic BP and prevents an increase in body fat in previously sedentary adults. This walking prescription, however, failed to induce significant improvements in other markers of cardiovascular disease risk following eight weeks of training.

Harrell et al. (1998), developed a piece of research whose aim was to determine the immediate effects of two types of elementary school-based interventions on children with multiple cardiovascular disease (CVD) risk factors. Four hundred and twenty-two children aged 9 +/- 0.8 years with at least two risk factors at baseline: low aerobic power and either high serum cholesterol or obesity. Both 8-week interventions consisted of a knowledge and attitude program and an adaptation of physical education. The classroom-based intervention was given by regular teachers to all children in the 3rd and 4th grades. The risk-based intervention was given in small groups only to children with identified risk factors. Children in the control group received usual teaching and physical education. The primary outcome measure was cholesterol; additional measures were blood pressure, body mass index, body fat, eating and activity habits, and health knowledge. RESULTS: Both interventions produced large reductions in cholesterol (-10.1 mg/dL and -11.7 mg/dL) compared with a small drop (-2.3 mg/dL) in the controls. There was a trend for systolic blood pressure to increase less in both intervention groups than in the controls. Both intervention groups had a small reduction in body fat and higher health knowledge than the control group. Both brief interventions can improve the CVD risk profile of children with multiple risk factors. The classroom-based approach was easier to implement and used fewer resources. This population approach should be considered as one means of early primary prevention of CVD.

As we have been able to see in the conclusions of the previously exposed works, aerobic exercise provokes an improvement in cardiovascular disease risk factors, thus a training program especially designed taking into account the needs and limitations of the patient allows the heart to adapt itself to variable situations, performing an adequate contraction at rest and an agile response during exercise.

8.3. Mechanism of Action

Taking into account the aforementioned facts, we can conclude that regular aerobic exercise is beneficial mainly for two reasons. First, it is a fundamental pillar in the modification of cardiovascular disease risk factors (it reduces blood pressure, improves peripheral circulation and so on) and secondly, it plays an important role in the prevention and treatment of functional capacity decline, because it improves articulatory movement range and muscular strength, especially in lower limbs, increases elasticity and tone and reduces muscular fatigue caused by insufficient postural hygiene in daily life activities. All these factors contribute to a significant improvement in people's quality of life. However, we must never forget that, although physical exercise is beneficial for cardiovascular diseases, patients must seek professional advice before taking up any kind of activity. Experts will plan and prescribe aerobic exercise and will design the guidelines for its proper performance according to the patient's physical fitness.

8.4. Physical Exercise Prescription in Cardiovascular Disease

It is a fact that those people who do aerobic exercise regularly develop a cardiac training effect, better recovery and basal heart rate which is able to respond with agility during exercise in order to increase heart performance. This is called heart-beneficial exercise because if it is combined with a serious limitation of risk factors such as smoking and excessive calorie intake, it will reduce blood pressure and cardiovascular risk profile, which enables the patient to achieve cardiovascular health. A minimum of 30 minutes of aerobic exercise 3-4 days per week is enough to keep a good physical condition. An ideal aerobic exercise program should include 5-10 minutes of warming-up, performing soft movements in order to increase heart rate. The patient should then perform gradually about 20 minutes of aerobic activity (such as aerobic gymnastics, treadmill jogging, walking, swimming) in order to reach training adulthood when it is more frequent in women. The cause for this tendency change is still not known but some experts suggest a possible lung immaturity in boys compared to girls during the first stages of life.

Asthma has been increasing in prevalence since 1980 (Mannino et al., 1998). During the1991–2001 period, the problem of asthma was the focus of programs and reports from governmental agencies (e.g., the National Heart Lung and Blood Institute's National Asthma Education and Prevention Program [NAEPP] (*NIH, 1993*) and the U.S. Department of Health and Human Services' Action Against Asthma report (*US-DHHS, 2001*) and nongovernmental commissions (e.g., the Pew Environmental Health Commission's Attack Asthma report (*PEHC, 2001*). A common feature of these reports and programs is a call for improved asthma surveillance. Asthma is a key component of the Healthy People 2010 objectives (*US-DHHS, 2000*).Costs generated by asthma in the United States were 6.2 billion dollars in 1990 and 12.7 billion dollars in 1998. According to estimations based on this last period, asthma costs for 2010 will exceed 20 billion dollars.

9.2. Aerobic Exercise and Asthma

Two out of three people who suffer from asthma feel unfit to perform aerobic exercise or to participate in recreational or physical activities, especially when they realise that exercise itself may provoke an asthma attack. Therefore, any kind of physical exercise performed by asthmatic patients must be adequately prescribed ir order to avoid an asthma episode. However, and in spite of these possible negative consequences for the patient, aerobic exercise facilitates breathing by strengthening the respiratory muscles and improves the patient's health, therefore doctors recommend exercise to asthmatic people as long as some basic guidelines are taken into account.

Different researchers have supported the idea that aerobic exercise has a beneficial effect on the asthmatic patients' health and on their quality of life. Fanelli et al., (2007) carried out a piece of research whose aim was to check if aerobic training was effective in improving cardiopulmonary fitness in asthmatic children. However, the actual impact of physical training on clinical indicators of disease control remains controversial. The sample group consisted of thirty-eight children with moderate to severe persistent asthma who were randomly assigned to control (N=17) and training (N=21) groups. The results showed that physical training was associated with significant improvements in physiological variables at peak and submaximal exercise ($P<0.05$); in contrast, no significant changes were found in controls. Severity of exercise-induced bronchoconstriction (EIB) and postexercise breathlessness were significantly lessened in trained patients; improvement in fitness and EIB, however, were not linearly related ($P>0.05$). Consequently, we can conclude that supervised exercise training might be associated with beneficial effects on disease control and quality of life in asthmatic children. These data suggest an adjunct role of physical conditioning on clinical management of patients with more advanced disease.

Another similar piece of research was carried out by Basaran et al., (2006), who assessed the effects of regular submaximal exercise on quality of life, exercise capacity and pulmonary function in asthmatic children. They included in their study sixty-two children with mild-moderate asthma (mean age 10.4 (SD 2.1) years) who were randomly allocated into exercise and control groups. The exercise group underwent a moderately intensive basketball training program for 8 weeks. A home respiratory exercise program was advised to both groups. Pediatric Asthma Quality of Life Questionnaire (PAQLQ) was used for the evaluation of activity limitation, symptoms and emotional functions. Although PAQLQ scores improved in both groups, the improvement in the exercise group was significantly higher. The exercise group performed better in the PWC 170 and 6-minute walk tests, whereas no improvement was detected in the control group at the end of the trial. Medication scores improved in both groups, but symptom scores improved only in the exercise group. No significant changes were detected in pulmonary function in either group, except for peak expiratory flow values in the exercise group. Therefore, we can claim that eight weeks of regular submaximal exercise have beneficial effects on quality of life and exercise capacity in children with asthma. Submaximal basketball training is an effective alternative exercise program for asthmatic children.

Recent reports indicate that aerobic exercise improves the overall physical fitness and health of asthmatic patients. The specific exercise-induced improvements in the pathology of asthma and the mechanisms by which these improvements occur, however, are ill-defined; thus, the therapeutic potential of exercise in the treatment of asthma remains unappreciated. Using an OVA-driven mouse model, Pastva, et al. (2004) examined the role of aerobic exercise in modulating inflammatory responses associated with atopic asthma. Data demonstrate that moderate intensity aerobic exercise training decreased leukocyte infiltration, cytokine production, adhesion molecule expression, and structural remodeling within the lungs of OVA-sensitized mice ($n = 6\text{-}10$; $p < 0.05$). Because the transcription factor NF-kappaB regulates the expression of a variety of genes that encode inflammatory mediators, we monitored changes in NF-kappaB activation in the lungs of exercised/sensitized mice. Results show that exercise decreased NF-kappaB nuclear translocation and IkappaBalpha phosphorylation, indicating that exercise decreased NF-kappaB activation in the lungs of sensitized mice ($n = 6$). Taken together, these results suggest that aerobic exercise attenuates airway inflammation in a mouse model of atopic asthma via modulation of NF-kappaB activation. Potential exists, therefore, for the amelioration of asthma-associated chronic airway inflammation through the use of aerobic exercise training as a non-drug therapeutic modality.

9.3. Mechanism of Action

Regular aerobic physical activity of adequate intensity and duration involving large muscle groups has been proved to have a number of potential beneficial effects on general health, including improvement in aerobic capacity, body composition, flexibility, muscular strength, and psychosocial measures. This improvement might be particularly true for patients who suffer from chronic diseases such as bronchial asthma. In people with asthma, physical training can improve cardiopulmonary fitness without changing lung function. This appeared to be a normal training effect and not due to an improvement in resting lung function. It is not known whether improved fitness is translated into improved quality of life. It is comforting to note that physical training does not have an adverse effect on lung function and wheeze in patients with asthma (Ram et al., 2005). Therefore, there is no reason why patients with asthma should not be able to participate in regular physical activities. When training asthmatic subjects, it would be appropriate to give them guidance about the prevention and treatment of exercise-induced asthma.

9.4. Physical Exercise Prescription in Asthma

Apart from an adequate control of asthma through medication, asthmatic patients must take into account some basic recommendations when doing exercise which include an adequate warming-up ad cooling down period in order to prevent and reduce the frequency of exercise-induced asthmatic crisis. The kind of exercise performed by the patient plays an important role to determine the degree of exercise-induced asthma. Outdoors running is the form of exercise which provokes the most exercise-induced asthma whereas indoors swimming provokes the least due to the fact that the air is hot and humid in the swimming pool and prevents cold and dryness in the airways. Another factor to take into account is the duration of physical exercise because continuous, intense and prolongued exercise causes more induced asthma than short-duration repetitive exercise. Intensity must also be taken into account because the higher the intensity of the aerobic exercise (80%-90% of maximum HR) the more likely the induced asthma will appear (Anderson, 1988). Breathing through the mouth instead of breathing slowly through the nose, not using any kind of mask when exercising in cold weather and not checking the place where exercise is going to be performed in order to eliminate irritating or allergenic substances can also bring about induced asthma. Having in mind these recommendations, an adequate selection of sport activities could help to prevent induced asthma. Swimming, wrestling, sprint racing and team sports such as football and baseball could be well tolerated (Rosimini, 2003).

Other activities which are associated to high incidence of induced asthma are particularly winter sports (except slalom ski) and those which involve long

races (for example cross-country races and basketball). However,it is possible for the patients to participate in these activities by using bronchodilatators for prophylaxis.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

10.1. DISEASE CHARACTERISTICS

The chronic obstructive pulmonary disease (COPD) is a group of diseases of the lungs in which the airways become narrowed (A reduction in forced expiratory volume during the first second and of the relationship expiratory volume/ forced vital capacity (GOLD, 2007; Peces-Barba G, 2008)). This leads to a limitation of the flow of air to and from the lungs causing shortness of breath. In contrast to asthma, the limitation of airflow is poorly reversible and usually gets progressively worse over time. COPD is caused by noxious particles or gases, most commonly from smoking, which trigger an abnormal inflammatory response in the lung. The inflammatory response in the larger airways is known as chronic bronchitis. In the alveoli, the inflammatory response causes destruction of the tissues of the lung, a process known as emphysema. The natural course of COPD is characterized by occasional sudden worsenings of symptoms called acute exacerbations, most of which are caused by infections or air pollution.

Chronic Bronchitis (Llor et al., 2006). It is is defined clinically as a persistent cough that produces sputum (phlegm) and mucus, for at least three months in two consecutive years, as long as cough is not produced by other causes such as cystic fibrosis, bronchiecstasis, higher airways obstruction or obliterans bronchiolitis.

Enphysema (Honig, 1998) It is defined in pathological terms as the permanent widening of distal air cavities of the terminal bronchioli with alveolar wall destruction and no manifest fibrosis. Those cases of chronic asthma with irreversible airflow obstruction deserve especial consideration because their characteristics make it difficult to use differential diagnose with COPD.

Historical data report COPD since the 16th century. Hippocrates did not use this term to diagnose patients who presented cough with phlegm, dyspnea and wheezing, but he employed "asthma" for all those conditions in which the patient showed shortness of air.

In those times, the term enphysema (from the Greek word "emphysao" which means "blowing inside") started to be used to refer to the presence of air inside the tissues. In the 17th century and based on studies on autopsies, the entities that we currently describe as COPD became known. However, the term "bronchitis" was used by medical literature until the end of the18th century. In 1958 a differentiated definition of chronic bronchitis, pulmonar enphysema and COPD was established (García, 2006).

The World Health Organization has foreseen that this illness will become the fifth cause of morbidity in 2020 (it is currently the 12th) and the third cause of mortality(it is currently the 4th).World prevalence of COPD ranges from 5-10%; percentage which has considerably increased due to smoking, population ageing and greater incidence observed in women. It is estimated that around 16 million people will suffer from it in the United States and it will become the fourth cause of death between 65 and 84 years of age. The economic impact of the disease is high, approximately 30 billion dollars in the United States (20 billion for direct costs and 10 billion for indirect costs) (Akazawa et al., 2008).

Aerobic exercise presents itself as one of the treatments proposed by international experts to fight Chronic Obstructive Pulmonary Disease (COPD). Physical exercise provokes an improvement in effort tolerance and in the general health state of the patient. It has been observed that some COPD patients suffer from anxiety, depression and social isolation as a consequence of the physical limitation that the typical airflow obstruction which is characteristic of this illness involves. Exercising offers the patient an opportunity to return to social life. (Clark et al., 1996; Normandin et al., 2002).

10.2. Aerobic Exercise and Chronic Obstructive Pulmonary Disease

Skeletal muscle dysfunction is one of the most serious extrapulmonary manifestations of chronic obstructive pulmonary disease (COPD). This dysfunction limits exercise tolerance and is associated with complaints of fatigue and dyspnea even after minimal exertion (ATSERSS, 1999). Deconditioning is almost certainly a contributing factor, given that patients with COPD have symptom-limited exercise tolerance, which compromises their cardiac fitness and further limits their exercise tolerance, leading to exacerbation of their symptoms after exertion.

The efficacy of aerobic programs in COPD patients has been well established. Endurance training of the lower extremities, resulting in greater exercise tolerance, is an important component of these programs (Celli & Macnee, 2004).

Borjen et al. (2009) carried out a study whos aim was to investigate whether individual leg cycling could produce higher whole body peak oxygen uptake (VO(2peak)) than two legs cycling during aerobic high intensity interval training in chronic obstructive pulmonary disease (COPD) patients. Nineteen patients trained in 24 supervised cycling sessions either by one leg training (OLT) ($n = 12$) or by two legs training (TLT) ($n = 7$) at 4 x 4 min intervals at 85-95% of peak heart rate. Whole body VO(2peak) and peak work rate increased significantly by 12 and 23% in the OLT, and by 6 and 12% in the TLT from pre- to post-training, respectively, and were significantly greater in the OLT than the TLT ($P < 0.05$). The present study demonstrates that one leg aerobic high intensity interval cycling is superior to two legs in increasing whole body VO(2peak), indicating a muscle rather than a cardiovascular limitation to VO(2peak) in these COPD patients.

Nakamura et al. (2008) evaluated whether strength or recreational activities are a useful addition to aerobic training in patients with chronic obstructive pulmonary disease (COPD). Thirty-three patients with moderate to severe COPD were randomly assigned to 12 weeks of aerobic combined with strength training (AERO+ST) or combined with recreational activities (AERO+RA). The AERO regime consisted of three weekly 20-min walking exercise sessions; the ST regime included three series of 10 repetitions of four exercises; and the RA regime consisted of training using exercise balls to perform smoothly for instrumental activity of daily living. Baseline and after-training measurements of peripheral muscular strength and endurance, cardio respiratory fitness, and 6-min walking distance were obtained, whereas quality of life was assessed with the Short Form 36 questionnaire. Change in grip strength showed a significant difference between the AERO+ST group (8.3+/-6.7%) and the control group (-1.3+/-10.5%), and AERO+RA group (-4.7+/-5.6%) ($P<0.05$). A significant increase was found in percentage change in peak (.)V(O2) between the AERO+ST group (5.1+/-11.8%) and the control group (-9.2+/-8.6%) ($P<0.05$). In the health-related quality of life scores, there was a significant difference in mean percentage change in physical functioning between the AERO+ST group (7.9+/-24.4%) and the control group (-14.8+/-19.1%) ($P<0.05$). A significant difference was found in mean percentage change in social functioning between the AERO+RA group (9.4+/-20.0%) and the control group (-14.9+/-23.2%) ($P<0.05$). A significant difference in mean percentage change in mental health was also found between the AERO+RA group (12.2+/-12.4%) and the control group (-5.0+/-7.8%) ($P<0.05$). It is preferable to introduce various forms of exercise than to use different muscles involving the whole body, such as recreational activities, as they are an appropriate approach to stimulating physical activity and to improving functional fitness gradually while improving health-related quality of life, though it is necessary to practice exercises for maintenance and improvement in patients with COPD.

Arnardóttir et al. (2006) compared the effects on exercise capacity and health-related quality of life (HRQoL) of two exercise programmes; one programme including endurance training and one including only resistance training and callisthenics. A second purpose was to find out whether the severity of chronic obstructive pulmonary disease (COPD) affected the training response and whether the interventions had a long-term effect. Sixty-three patients were stratified according to severity of COPD and randomised to two training groups. Group A had a mixed programme including endurance training. Group B had resistance training and callisthenics. All trained twice weekly for 8 weeks. A symptom-limited ergometer test, 12-min walking test, dynamic spirometry, blood gas analysis at rest and HRQoL were measured before and after the training period. Follow-up tests were conducted at 6 and 12 months after training. Forty-two patients fulfilled the trial. In group A (n=20) peak exercise capacity increased by 7W ($P<0.001$) and 12-min walking distance (12MWD) by 50 m ($P<0.01$), whereas group B (n=22) did not change in any of these variables. HRQoL did not change significantly in either group. Training response was similar in patients with moderate and severe disease. One year post-training 12MWD had returned to pre-training level in group A, and below pre-training level in group B ($P<0.05$). The conclusion was that exercise capacity in patients with severe and moderate COPD improved by intensive endurance training, two sessions a week for 8 weeks. The improvement was however small and HRQoL did not improve. Severity of illness did not affect response to training. The results indicated that the effects of a short endurance training intervention slowed down decline in baseline functional exercise capacity for 1 year.

These studies corroborate that regular physical exercise such as walking or cycling is effectively associated with a decrease in pulmonary function deterioration and with an improvement in the the patient's health.

10.3. Mechanism of Action

The shortness of breath experienced by COPD patients at rest and/or during activities of daily living can lead to an increasingly sedentary lifestyle, a progressive deterioration in functional capacity, and possible isolation at home. With progressive inactivity, cardiovascular function and skeletal muscle mass decline. The deterioration in aerobic fitness and strength creates a vicious cycle that leads to greater breathlessness with exertion, muscular fatigue, eventual loss of functional independence and depression. A major goal of aerobic exercise programs is, therefore, to reverse the physical disability resulting from inactivity. Aerobic Exercise, at almost any level, improves the oxygen utilization, work capacity, and state of mind of COPD patients. Low-impact activities place minimum stress on joints and are easier to perform than high-intensity activities.

Many physiological and psychological benefits have been reported in COPD patients after participation in prescribed exercise involving upper and lower body aerobic and resistance training.

Major benefits include increased physical capacity, decreased anxiety about breathlessness, greater independence in daily activities, reduced fatigue and improved quality of life. These positive outcomes occur even through impaired lung function continues to persist after exercise training. Regular exercise thus enables COPD patients to do more recreational and vocational activities despite their lung disease. Importantly, the gain in fitness and confidence with exercise reverses the

spiral of deconditioning associated with COPD. One reason of the decreased exercise anxiety is that patients become desensitized to the shortness of breath that they live with on a daily basis. Furthermore, researchers have shown that COPD patients who exercise may also show better performance on tests of verbal fluency (Emery et al., 1998)., suggesting that regular exercise increases blood flow to the brain to enhance cognitive function.

10.4. Physical Exercise Prescription in COPD

Exercise guidelines for COPD patients include 30-minute sessions 3-4 times a week for a period of 6-8 weeks (Cooper, 2001) for the patient to be able to notice an improvement, althought the patient's perception of his improvement will be conditioned by his disease status. However, other studies show an improvement in the patient from the fourth week on (Cochrane, 2002). As far as intensity is concerned, there is no unanimity among researchers. Casaburi et al. (1997) and Ries et al. (1995) showed that patients trained at a higher intensity presented better physiological responses such as lactate decrease, minute ventilation, HR and VO2, but they required a closer supervision and stimulus. By contrast, other researchers obtained better responses to low to moderate intensity training in COPD patients.

According to the British Thoracic Society standards (BTS, 2001), in order to obtain the desired results an aerobic program must last at least for 4 to 12 weeks, 2-5 times a week, in 20-30 minute sessions and at an intensity of 60% of VO2 max. The plan must be progressively adjusted in duration and intensity, taking into account the fact that the higher intensity, the more lasting the effects. According to GOLD (2003) the optimal duration of an exercise program has not been established in randomized and controlled clinical studies, so this depends on available resources; however, they suggest a duration varying from 4 to 10 weeks, with longer lasting effects in those patients who participate in longer training programs.

MULTIPLE SCLEROSIS

11.1. DISEASE CHARACTERISTICS

Multiple Sclerosis (MS) is an inflammatory disease of the central nervous system (CNS) which was discovered by Dr. Charcot in 1868. There are about 300,000 patients suffering from Multiple Sclerosis in North America today. The peak onset is between 20 and 30 years of age. Almost 70% of patients manifest symptoms between ages 21 and 40. This disease rarely occurs prior to 10 or after 60 years of age. Multiple Sclerosis affects young and genetically predisposed people who have been exposed during their childhood to one or more adverse environmental conditions, probably viruses. It causes a dysfunction in the immune system, which develops a self-damaging action, mainly directed against the white substance. A series of plaque-shaped scars appear in different zones on the CNS and hence the disease's name, Multiple Sclerosis (multiple scars) or plaque sclerosis (Cambier, 2003). The typical symptoms of the illness are varied, but the commonest are visual disorder, fatigue, balance and coordination problems and muscular weakness among others. Due to this variability, the criteria for its diagnosis include complex neurological tests, such as evoked potential, magnetic resonance and analysis of the cephalorachidian fluid. Multiple Sclerosis can present itself in outbreaks or progressively, provoking a degenerative disability to those who suffer from it, and in some cases even death. There is no completely effective treatment against it, although some drugs like "Interferon" have demonstrated some efficacy in slowing down the advance of the illness. Although for many years MS patients were advised to avoid exercise, nowadays physical activity is regarded as a useful tool that should be part of every neurological rehabilitation program.

11.2. Aerobic Exercise and Multiple Sclerosis

For years, the relationship between MS and physical exercise was considered very harmful. Neurologists thought that MS patients should direct their energies to the performance of everyday activities, and keep away from physical exercise, since the rising in body temperature produced by it could exacerbate the signs of the illness. Besides, it was also taken into account the fact that other typical illness symptoms were likely to appear, such as Lhermitte's (an electric discharge which runs along the spine), or to become acute, such as fatigue.

According to the bibliography on the matter (Ayán, 2007), it was not before the 1970's when a former American Olympic champion, Jimmie Heuga was diagnosed with MS. Far from following the medical advice, this elite sportsman kept on training and exercising as much as his illness allowed him to do it, thus altering the scientific community's traditional point of view on the issue, and founding a centre in Colorado, The Jimmie Heuga Center, to offer an opportunity to those people willing to get involved in scientific research aimed at determining the role of exercise in MS patients.

In the early 1980's research on the effects of aerobic exercise on MS began to shape up, and it was based on aquatic activities, because floating enables the performance of movements and water temperature decreases the risk of temperature regulation problems. However, the most important reason to advise exercising in water is the recreational possibilities that this element offers. When a person suffers from MS, fatigue and muscular weakness prevent him or her to perform physical and recreational activities, thus missing the satisfaction of enjoying exercises and games in the company of friends and relatives. These inconveniences increase the time that the individuals spend stuck at home and therefore, their mood gets worse, and they end up with depression, which in turn makes the patients to isolate themselves even more. Nevertheless, given that MS patients can move through water, and their muscular weakness is a less important handicap in water than on land, swimming pools and aquatic parks are ideal places for them not only to exercise, but also to be able to participate and enjoy recreational activities in the company of their loved ones, thus fighting off the negative psychological effects previously mentioned.

One of the first pieces of research which aimed at examining fitness improvement in MS patients after the performance of aquatic exercises was carried out by Gehslen et al. (1984), who recruited ten physically autonomous patients to participate in an aquatic training program which lasted for ten weeks, with the objective of studying the changes in their muscular resistance and strength. The training sessions were based on the performance of basic gymnastic exercises combined with several swimming styles, in three one-hour sessions per week. Intensity was established around 60%-75% of the maximum heart rate and water temperature oscillated between 25ºC and 27ºC. At the end of the program, it was observed, through dynamometric tests, an increase in muscular strength in all of the patients, along with a reduction in fatigue, which reinforced the hypothesis of the potential benefits of aquatic exercise. In another similar study (Sutherland et al., 2001) 22 patients were recruited, 11 of whom received aerobic training in a swimming pool three times a week for a period of ten weeks. When comparing their health state with that of the other individuals through several questionnaires, the researchers found that those patients who had participated in the training sessions not only presented less fatigue and a greater feeling of good health, but also confessed to have improved their sexual and social lives.

As far as the effectiveness of aerobic exercise outside the water is concerned, Olgiati et al. (1986), recruited 11 MS patients and submitted them to a rehabilitation program which lasted for four weeks and which consisted of light aerobic exercises. By the end of the program, the individuals proved to be able to walk faster and to cover longer distances before fatigue appeared when comparing them to a control group. These results suggest a possible cardiorespiratory improvement provoked by exercise, and they constitute an important antecedent for later research. Aerobic training became a very common tool in this kind of research. However, it could not be applied to everyone, due to the inability to walk that many MS patients present. Thus, new adapted cyclo-ergometers were created, designed to exercise upper and lower limbs, such as those used by Gappmaier et al. (1994), who designed an aerobic program to determine the effects of 15 weeks of training, structured in 3-4, 40-minute sessions a week. MS patients pedalled at an intensity around 60% of their VO2 max. After finishing the intervention, their aerobic capacity improved up to 21% and their epidermis thickness decreased down to 15%.

Similar research showed that this kind of patients can benefit from aerobic training regardless of their physical disability, and that its effects do not only affect them at a conditional level. In fact, the most recent scientific works point out that short aerobic training programs (lasting for less than 3 months) can help to improve MS patients' quality of life (Motl & Gosney, 2008) and even reduce their level of fatigue (Newman et al., 2007). For these reasons, aerobic exercise should be included in the neurorehabilitation process of the illness.

11.3. Mechanism of Action

Aerobic exercise can be beneficial for MS patients for several reasons. First, this kind of patients experience fatigue and muscular weakness and tend to adopt a sedentary behaviour which aggravates their problems even more. When they participate in a training program, they abandon their sedentary routine and break that vicious circle, improving their well-being. Besides, the conditional improvements allow them to cope more efficiently with everyday routines and duties, reduce their level of fatigue and make them feel better. All these effects bring about a physical, psychological and social improvement that provokes an increase in the patient's quality of life.

Because of this, it has been stated that the effect of aerobic exercise training on the quality of life in MS is comparable in magnitude to the positive effects of disease modifying medications on the rate of exacerbations in MS and chronic exercise on mental health outcomes of cognitive function and feelings of energy and fatigue.

11.4. Physical Exercise Prescription in MS

In order to plan and carry out an exercise program for MS patients it must be taken into account that fatigue and increased body temperature will be the major limiting factors. After a thorough neurological examination to find out the individual's level of disability, the training program will be customized for the patient, paying attention to possible specific problems in coordination, ataxia, spasticity and motivation of every patient. The following tables proposes an example of exercise prescription:

Age	Disability level	Exercise	Charge
20-35	Mild and sensory.	Running	15-20 min. 120 beats/min
20-45	Respects lower limb	Walking-running	1-5 min. walk / 5-10 min. run
------	Affects lower limb	Mild walk	60 min. Individual rest

Table 6. Example of protocol for aerobic walking-based training.

Intensity	Volume	Frequency
50-60% de max. HR	20 min.	4 days/week
60-75% de max. HR	30 min.	3 days/week

Table 7. Protocol for the performance of aerobic exercise in exercise bycicle.

CROHN'S DISEASE

12.1. BASIC ASPECTS OF THE ILLNESS

Crohn's disease (CD) is defined as a chronic, relapsing inflammatory disorder of the alimentary canal which may involve anywhere from the mouth to the anus. Although it was first described by Giovanni Battista in the 18th century and by the Polish surgeon Dr. Lesniowski in the 20th century, it was named after the American gastroenterologist Bernard Crohn, who described fourteen cases in 1932 and gave the illness a new clinical identity (Blumberg, 2008).

Crohn's disease affects approximately 380,000 to 480,000 people in the United States. Although it may occur at any age, the incidence is bimodal with a peak in the third decade of life and a smaller peak in the fifth decade. The etiology of Crohn's disease is unknown, but suggested possibilities include genetic, environmental, immunologic, and infectious causes. An imbalance in local mucosal production of pro-inflammatory cytokines over anti-inflammatory cytokines is theorized to cause the well-demarcated, discontinuous, transmural, ulcerative lesions characteristic of the disease (Knutson, 2003). The diagnosis of Crohn's disease is based on a combination of exams: endoscopy, X-rays and histologic blood and tissue tests. The illness alternates flare-ups with states of remission and its most frequent symptoms are diarrhoeal bowel movements, abdominal pain and fever, among others. The current pharmacologic treatment can achieve the illness' remission in the long term, although acute cases are treated with steroids and surgery. Some lifestyle modifications such as changing some dietary habits and taking up some kind of activity have been suggested as factors which could induce an improvement in the patients' quality of life. Therefore, physical exercise may play an important role in this respect.

12.2. Aerobic Exercise and Crohn`s Disease

Although different epidemiological investigations have found and inverse relationship between CD development and occupational and recreational physical activity (Sonenberg, 1990), very few clinical relevant studies have evaluated the effects of an aerobic exercise intervention in patients experiencing CD. In this regard, Loudon et al. (1999) evaluated the effects of a 12-week mild walking program in 16 CD patients with inactive or mildly active disease. Once the intervention ended, physical health, general well-being, quality of life and perceived stress improved in some patients without disease exacerbation. Although the study presented some methodological flaws that can limit its findings, such as lack of a control group and small sample size (only 12 patients finished the program), a 6-month post study intervention showed that 50% of the completers were continuing to exercise between two and six days per week, suggesting that CD patients obtain some benefit from exercising. Separately, D'Inca et al. (1999), evaluated the effect of one-hour's exercise at a maximum of 60% oxygen in six males with ileal Crohn's disease in remission. Although a biochemical analysis showed that the patients at rest had primed neutrophils with increased activation after exercise, the proposed physical training did not elicit subjective symptoms or changes in intestinal permeability and lipoperoxidation. Since without symptom correlation, the clinical impact of this activation is hard to asses, this study shows that short-term exercise appeared to be well tolerated by CD patients in remission.

Finally, Ng et al. (2007) built on the preliminary work done by Loudon et al.(1999) by including a control group and proposing and independent walking program. In this study patients were instructed to walk 30 for minutes at a low intensity, three times per week during three months. All of the sixteen subjects included in the exercise group completed the program, without suffering any disease exacerbation. Once the intervention finished, the obtained data showed that a low-intensity exercise program was enough to elicit improvements in quality of life and to decrease Crohn's disease-related symptoms.

In the light all of this, it seems intuitively appealing to promote participation in regular exercise in the management of CD.

12.3. Mechanism of Action

The aerobic training works by breaking a vicious cycle. Fatigue and low energy feeling together with muscle weakness limit the patient's physical functioning. The training aims to improve fitness, thereby reducing fatigue. Besides aerobic activities can enhance muscle performance, thereby enabling the patient to better manage daily life. In addition, it is likely that the patient benefits psychologically from experiencing these fitness improvements. However, it is important to note that Crohn's disease involves an immune system dysfunction. Research has implicated the proinflammatory cytokines interleukin-6 (IL-6) and tumour necrosis factor-alpha (TNF-α) in the intestinal inflammation inherent to CD (Lee et al., 2005). Although physical activity appears to reduce these inflammation markers, the results of several studies involving cycling, running, swimming and resistance exercises are controversial and no clear pattern emerges from them, so in this regard, more research is needed.

In spite of all this, physical exercise has been regarded as a useful tool when treating some of the symptoms that are strongly related to CD, such as pain, fatigue, bone mineral loss, sleep disturbances, bone mineral density, body composition and even intestitnal problems. It may be that physical exercise could improve quality of life in this kind of patients by means of attenuating some or all of this symptoms.

12.4. Physical Exercise Prescription in CD

When considering including physical activity in CD treatment, physicians need to know the different types of recommendable exercises that exist, as well as the determining aspects of duration, intensity, frequency and progression involved in them, in order to be able to prescribe them safely to CD patients. Some basic guidelines for carrying out aerobic exercise interventions with people suffering from CD can be found in the findings of the reviewed clinical studies.

According to several physical exercise interventions carried out with people suffering from different inflammatory pathologies, walking appears to be a safe, practical and easy-to-do form or aerobic exercise. Because of that, and giving its effects on the QoL of CD patients, walking is the main type of aerobic activity that should be recommended. Regarding the level of effort, it has been found that aerobic activity performed at an intensity between 40% and 60% of maximal oxygen consumption does not affect intestinal impermeability. Simultaneously, it has been shown that CD patients can walk and average distance of 3.5 kilometres without experiencing symptoms' exacerbation. Giving all that, physicians can prescribe 20 to 30 minutes of low intensity walking at 60% of individual's maximal heart rate, three days per week to start with. Once the patients get used to this exercise prescription, they should be encouraged to perform the same schedule during most days of the week. However, aerobic activity must be stopped whenever the patient feels that fatigue or CD related symptoms show some sign of exacerbation. Moreover, if CD patients cannot follow the exercise regime proposed, they should walk continuously at their own pace during bouts of 4 or 5 minutes, in order to obtain a minimum of 20 minutes of activity per day.

Finally, it must be noted that currently there is not available information regarding the effects of different types of aerobic exercise on CD patients such as cycling, swimming or weight-bearing walking. In this regard, further research is needed before any advice can be given.

References

Ablin, J., Neumann, L.B. & Buskila, D. (2008) Pathogenesis of fibromyalgia – a review. *Joint Bone Spine, 75*, 273-279.

Aceves-Avila, F.J., Medina, F. & Fraga, A. (2001). The antiquity of rheumatoid arthritis: a reappraisal. *The Journal of Rheumatology, 28*, 691-693.

Agre, J.C., Pierce, L.E., Raab, D.M., McAdams, M., & Smith, E.L. (1988). Light resistance and stretching exercise in elderly women: effect upon strength. *Archives of Physical Medicine and Rehabilitation,69*, 273-276.

Ahlborg, H.G., Johnell, O., Turner, C.H., Rannevik, G., & Karlsson, M.K. (2003). Bone loss and bone size after menopause. *The New England Journal of Medicine, 349*, 327–34.

Akazawa, M., Halpern, R., Riedel, A.A., Stanford, R.H., Dalal, A., & Blanchette, C.M. (2008). Economic burden prior to COPD diagnosis: a matched case-control study in the United States. *Respiratory Medicine,* 102, 1744-52.

Alastair, J.J. & Wood. (1998). Treatment of postmenopausal osteoporosis. *The New England Journal of Medicine, 338*, 736-746.

American College of Sports Medicine. (1990) The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. *Medicine & Science in Sports & Exercise, 22*, 265-74.

American College of Sports Medicine. (1999). *Manual ACSM para la valoración y prescripción del ejercicio.* Barcelona: Paidotribo.

American Diabetes Association, www.diabetes.org. [Accesed march 10th 2009].

American Thoracic Society-European Respiratory Society Statement. (1999). Skeletal muscle dysfunction in chronic obstructive pulmonary disease. American Journal of Respiratory and Critical Care Medicine , *159*, 1s-28s.

Anderson, S.D. (1998). Exercise-induced asthma. En: Middleton E, Reed C, Ellis E, Adkinson NF, Yunginger JW (eds). *Allergy: Principles and practice*. (3rd. Edition). St. Louis: CV Mosby Cº.

Andreoli, A., Monteleone, M., van Loan, M., Promenzio, L., Tarantino, U., & De Lorenzo, A. (2001). Effects of different sports on bone density and muscle mass in highly trained athletes. *Medicine & Science in Sports & Exercise, 33*, 507-11.

Arnardóttir, R.H., Sörensen, S., Ringqvist, I., & Larsson, K. (2006). Two different training programmes for patients with COPD: a randomised study with 1-year follow-up. *Respiratory Medicine,, 100*, 130-9

Arnett, F.C., Edworthy, S.M., Bloch, D.A., McShane, D.J., Fries, J.F., Cooper, N.S., et al. (1988) The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. *Arthritis & Rheumatism, 31*, 315–24.

Assis, M. R. Silva, L.E., Alves, A.M., Pessanha, A.P., Valim, V., Feldman, D., et al. (2006). A randomized controlled trial of deep water running: clinical effectiveness of aquatic exercise to treat fibromyalgia. *Arthritis & Rheumatism, 55*, 57-65.

Ayán, C. (2007). *Esclerosis Múltiple y Ejercicio Físico*. Sevilla: Wanceulen.

Ayán, C. & Martín, V. (2007). Systemic lupus erythematosus and exercise. *Lupus, 16*, 5-9.

Bacon, S.L., Sherwood, A., Hinderliter, A., & Blumenthal, J.A. (2004). Effects of exercise, diet and weight loss on high blood pressure. *Sports Medicine*, *34*, 307-316.

Bailey, D.A., McKay, H.A., Mirwald, R.L., Crocker, P.R., & Faulkner, R.A. (1999). A six-year longitudinal study of the relationship of physical activity to bone mineral accrual in growing children: the university of

Saskatchewan bone mineral accrual study. *Journal of Bone and Mineral Research, 14,* 1672-9.

Barbado, C. (2001). Revisión bibliográfica sobre osteoporosis y actividad fisica. www.sectorfitness.com. [Accesed march 22th 2009].

Basaran, S., Guler-Uysal, F., Ergen, N., Seydaoglu, G., Bingol-Karakoc, G., Ufuk Altintas, D. (2006). Effects of physical exercise on quality of life, exercise capacity and pulmonary function in children with asthma. *Journal of Rehabilitation Medicine, 38*, 130-5.

Baster, T. & Baster-Brooks, C. (2005). Exercise and hypertension. *Australian Family Physician, 34*, 419-424.

Bellver, M. & Pujol, P. (1997). *Osteoporosis y Ejercicio Físico*. CAR, Sant Cugat del Vallés en Temas actuales en Actividad Física y Salud. Menarini. Barcelona.

Birge, S.L. & Daisky, G. (1989). The role of exercise in preventing osteoporosis. *Public Health Reports, 104,* 54-58.

Bjørgen, S., Hoff, J., Husby, V.S., Høydal, M.A., Tiønna, A.E., Steinshamn, S. et al. (2009). Aerobic high intensity one and two legs interval cycling in chronic obstructive pulmonary disease: the sum of the parts is greater than the whole. *European Journal of Applied Physiology*, *106*, 501-507.

Blumberg, R.S. (2008). Crohn disease. *Journal of American Medical Association, 300*, 439-440

British Thoracic Society Standards of Care Subcommittee on Pulmonary Rehabilitation. (2001). BTS Statement: Pulmonary Rehabilitation. *Thorax, 56*, 827-834.

Busch, A.J., Barber, K.A., Overend, T.J., Peloso, P.M., & Schachter, C.L. (2007). Exercise for treating fibromyalgia syndrome. *Cochrane Databases Systemic Review, 4*, CD003786

Cambier, J., Masson, M., & Dehen, H. (2003). *Esclerosis en Placas*. Barcelona: Masso.

Cancela, J.M. & Ayán, C. (2007). Effects of High-Intensity Combined Training on Women over 65. *Gerontology,* 53, 340-346

Carvalho, M., Sato, E., Tebexreni, A., Heidecher, R.T,, Schenkman, S., & Neto, T.L. (2005). Effects of supervised cardiovascular training programme on exercise tolerance, aerobic capacity and quality of life in patients with systemic lupus erythematosus. *Arthritis & Rheumatism, 53*, 838–844.

Casaburi, R., Porszasz, J., Burns, M.R., Carithers, E.R., Chang, R.S., Cooper, C.B. (1997). Physiologic benefits of exercise training in rehabilitation of patients with chronic obstructive pulmonary disease. *American journal of respiratory and critical care medicine, 155*, 1541-51.

Celli, B.R. & MacNee, W. (2004). Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. *European Respiratory Journal, 23*, 932-946.

Centers for Disease Control and Prevention (CDC). (1994). Arthritis prevalence and activity limitation: United States, 1990. *MMWR Morbidity and Mortality Weekly Report, 43*, 433–8.

Chintanadilok, J. & Lowenthal, D.T. (2002). Exercise in treating hypertension (tailoring therapies for active patients). The Physician and Sportsmedicine, *30,* 11-23.

Church, T.S., Earnest, C.P., Skinner, J.S., Blair, S.N.. (2007). Effects of different doses of physical activity on cardiorespiratory fitness among sedentary, overweight or obese postmenopausal women with elevated blood pressure: a randomized controlled trial. *Journal of American Medical Association,* 297, 2081-2091.

Clark, C.J., Cochrane, L., & Mackay, E. (1996). Low intensity peripheral muscle conditioning improves exercise tolerance and breathlessness in COPD. *The European Respiratory Journal, 9*, 2590-2596.

Clarke-Jenssen, A., Fredriksen, P., Lilleby, L., & Menghsoel, A. (2005). Effects of supervised aerobic exercise in patients with systemic lupus erythematosus: a pilot study. *Arhtritis& Rheumatism, 53*, 308–312.

Compston, E. (1992). HRT and osteoporosis. *British Medical Bulletin, 48*, 309-344.

Cooper, C., Campion, G. & Melton, L.J. (1992). 3rd Hip fractures in the elderly: a world-wide projection. *Osteoporos Int, 2*, 285-9.

Cooper, C.B. (2001). Exercise in chronic pulmonary disease: aerobic exercise prescription. *Medicine & Science in Sports & Exercise, 33* Suppl, 671-79.

Courteix, D. et al. (1998). Effects of Physical Training on Bone Mineral Density in Prepuberal Girls: A Comparative Study Between Impact-Loading and Non-Impact-Loading Sports. *Osteoporosis International, 8*, 152-158.

Cranney, A., Papaioannou, A., Zytaruk, N., Hanley, D., Adachi, J., Goltzman, D. et al. (2006). Clinical Guidelines Committee of Osteoporosis Canada. Parathyroid hormone for the treatment of osteoporosis: a systematic review. *Canadian Medical Association Journal, 175*, 52-9.

D'Inca, R., Varnier, M., Mestriner, C., Martines, D., D'Odorico, A., & Sturniolo, G. (1999). Effects of moderate exercise on Crohn's disease patients in remission. *Italian Journal of Gastroenterology Hepatology, 31*, 205-210

De Angelis, K., da Pureza, D. Y., Flores, L.J.F, Rodrigues, B., Melo, K,F.S., Schaan, B.D. et al. (2006). Efeitos Fisiológicos do Treinamento Físico em Pacientes Portadores de Diabetes Tipo 1. *Arquivos Brasileiros de Endocrinologia & Metadologia, 50*, 1005-1013.

Del Rio, L. & Roig, D. (2001). Actividad Física y Calidad Ósea. *Archivos de Medicina del Deporte, 18*, 211-21.

Duppe, H., Gardsell, P., Johnell, O., Nilsson, B.E., & Ringsberg, K. (1997). Bone mineral density, muscle strength and physical activity. A population-based study of 332 subjects aged 15-42 years. *Acta Orthopaedica Scandinavica, 68*, 97-103.

Ekdahl, C. & Broman, G. (1992). Muscle strength, endurance, and aerobic capacity in rheumatoid arthritis: a comparative study with healthy subjects. *Annals of the Rheumatic Diseases, 51*, 35–40.

Emery, C.F., Schein, R.L., Hauck, E.R. & MacIntyre, N.R. (1998) Psychological and cognitive outcomes of a randomized trial of exercise among patients with chronic obstructive pulmonary disease. *Health Psychology, 17*, 232-40.

Fanelli, A., Cabral, A.L., Neder, J.A., Martins, M.A., & Carvalho, C.R. (2007). Exercise training on disease control and quality of life in asthmatic children. *Medicine & Science in Sports & Exercise, 39*, 1474-80

Fenster, C.P., Weinsier, R.L., Darley-Usmar, V.M., & Patel, R.P. (2002). Obesity, Aerobic exercise and vascular disease: the role of oxidant stress. *Obesity Research, 10*, 964-968.

Finckh, A., Iversen, M. & Liang, M.H. (2003) The exercise prescription in rheumatoid arthritis: primum non nocere. *Arthritis & Rheumatism, 48*, 2393-5.

Gappmaier, E., Spencer, M., With, A., et al. (1994). Fifteen weeks of aerobic training improves multiple sclerosis patients' fitness. *Medicine & Science in Sports & Exercise, 26,* 432-441

García, M.A. (2006). Setenta y un años de historia de la EPOC en el Instituto Nacional de Enfermedades Respiratorias Ismael Cosío Villegas (1935-2006). *Revista del Instituto Nacional de Enfermedades Respiratorias, 19*(4), 316-20

Gaudin, P., Leguen-Guegan, S., Allenet, B., Baillet, A., Grange, L., & Juvin, R. (2008) Is dynamic exercise beneficial in patients with rheumatoid arthritis? *Joint Bone Spine, 75*, 11-17.

Ghelsen, G., Grisby, S. & Winant, D. (1984). Effects of an aquatic fitness program on the muscular strength and endurance of patients with multiple sclerosis. *Physical Therapy, 64*, 635-657

Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2007). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. Bethesda (MD): Global Initiative for Chronic Obstructive Lung Disease, World Health Organization, National Heart, Lung and Blood Institute.

Global Initiative for Obstructive Lung Disease (GOLD). www.goldcopd.com, [Accesed march 18th 2009].

Goran, M.I., Reynolds, K.D. & Lindquist, C.H. (1999). Role of physical activity in the prevention of obesity in children. *International Journal of Obesity, 23,* S18-S33.

Gordon, B.A., Benson, A.C., Bird, S.R., & Fraser, S.F. (2009). Resistance training improves metabolic health in type 2 diabetes: a systematic review. *Diabetes Research and clinical practice, 83*, 157-175.

Grupo de trabajo de Actividad Física y Salud (GAFyS). (2006). *Prescripción de ejercicio en el tratamiento de enfermedades crónicas.* Barcelona: Semfyc.

Guyton, A.C. & Hall, J.E. (2001). *Tratado de fisiología médica*. Madrid: McGraw Hill/ Interamericana.

Hagberg, J.M., Park, J.J. & Brown, M.D. (2000). The role of exercise training in the treatment of hypertension. *Sports Medicine, 30*, 193-206.

Halbert, J.A., Silagy C.A., Finucane, P., Withers, R.T., Hamdorf, P.A. & Andrews, G.R. (1997). The effectiveness of exercise training in lowering blood pressure: a meta-analysis of randomised controlled trials of 4 weeks or longer. *Journal of human hypertension, 11*, 641-649.

Harkcom, T.M., Lampman, R.M., Banwell, B.F., & Castor CW. (1985). Therapeutic value of graded aerobic exercise training in rheumatoid arthritis. *Arthritis & Rheumatism, 28*,32–9.

Harrell, J.S., Gansky, S.A., McMurray, R.G., Bangdiwala, S.I., Frauman, A.C, & Bradley, C.B. (1998). School-based interventions improve heart health in children with multiple cardiovascular disease risk factors. *Pediatrics, 102*, 371-80

Harris, E.D. Jr., Budd, R.C., Genovese, M.C., et al. eds. (2005) *Kelley's Textbook of Rheumatology.* (7th ed). Philadelphia: Saunders Elsevier.

Harris, M.I., Flegal, K.M., Cowie, C.C., Eberhardt, M.S., Goldstein, D.E., Little, R.R. et al. (1998). Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in US adults: the Third National Health and Nutrition Examination Survey, 1988-1994. *Diabetes Care, 21*,518-524.

Henderson, N. K., White, C. P. & Eisman, J. A. (1998). The Roles of Exercise and Fall Risk Reduction in the Prevention of Osteoporosis. *Endocrinology and metabolism clinics of North America, 27*, 369-87.

Honda, A., Umemura, Y. & Nagasawa, S. (2001). Effect of high-impact and low-repetition training on bones in ovariectomized rats. *Journal of Bone and Mineral Research, 16*, 1688-93.

Honig, E.G. & Ingram, R.H. Jr. (1998). Chronic bronchitis, emphysema, and airways obstruction. En: Isselbacher Kl, Braunwald E, Wilson SD, et al, editors. *Harrison's principles of internal medicine*. (14th ed, pp. 1451-9). New York: McGraw-Hill.

Hui, S.L., Slemenda, C.W. & Johnston, C.C. (1990). The contribution of bone loss to postmenopausal osteoporosis. *Osteoporos International, 1*, 30–4.

Impallomeni, M. & Santodirocco, A. (2003). Osteoporosis en el anciano. *Revista Española de Geriatría y Gerontología, 38*(1), 54-59.

Irwin, M.L., Yasui, Y., Ulrich, C.M., Bowen, D., Rudolph, R.E., Schwartz, R.S. et al. (2003) Effect of exercise on total and intra-abdominal body fat in postmenopausal women. A randomized controlled trial. *The journal of the American Medical Association, 289*, 323-330.

Jakicic, J.M. & Otto, A.D. (2005). Physical activity considerations for the treatment and prevention of obesity. *The American journal of clinical nutrition, 82*, 226S-229S.

Jakicic, J.M., Marcus, B.H., Gallagher, K.I., Napolitano, M., & Lang, W. (2003). Effect of exercise duration and Intensity on weight loss in overweight, sedentary women: a randomized trial. *The journal of the American Medical Association, 290*, 1323-1330.

Karlsson, M.K., Nordqvist, A. & Karlsson, C. (2008). Physical activity increases bone mass during growth. *Food & Nutrition Research, 52*: 10.

Katz, R.S., Wolfe, F. & Michaud, K. (2006). Fibromyalgia diagnosis: a comparison of clinical, survey, and American College of Rheumatology criteria. *Arthritis & Rheumatism, 54*, 169-176

Kavookjian, J., Elswick, B.M. & Whetsel, T. (2007). Interventions for being active among individuals with diabetes: a systematic review of the literature. *The Diabetes Educator, 33*, 962-988.

Kelley, G.A., Kelley, K.S. & Tran, Z.V. (2005). Aerobic exercise, lipids and lipoproteins in iverweight and obese adults: a meta-nalysis of randomized controlled trials. *International journal of obesity, 29*, 881-893.

Komatsu, W.R., Gabbay, M.A.L., Castro, M.L., Saraiva, G.L., Chacra, A.R., de Barros Neto, T.L. et al. (2005). Aerobic exercise capacity in normal adolescents and those with type 1 diabetes mellitus. *Pediatric Diabetes, 6*, 145-149.

Krall, E.A., Garcia, R.I. & Dawson-Hughes, B. (1996). Increased risk of tooth loss is related to bone loss at the whole body, hip, and spine. *Calcified Tissue International, 59,* 433–437.

Landre Beauvais, A.J. (2001). The first description of rheumatoid arthritis. Unabridged text of the doctoral dissertation presented in 1800. *Joint Bone Spine, 68*, 130-143.

Lee, N., Radford-Smith, G. & Taaffe, D. (2005). Bone loss in Crohn's disease: exercise as a potential countermeasure. *Inflammatory Bowel Disease, 11,* 1108-1118

Lewis, R. D. & Modlesky, C. M. (1998). Nutrition, Physical Activity and Bone Health in Women. *International journal of sport nutrition, 8*, 250-84.

Lindroth, Y., Strombeck, B., Brosner, M., Gullberg, B., & Wollheim, F. (1994). Learned helplesnes and to impairment, paint, anxiety on depresion, in rheumatoid arthritis. *Scandinavian Journal Rheumatology, 23,* 299-304.

Llor, C., Naberan, K., Cots, J.M., Molina, J., Ros, F., & Miravitlles, M. (2006). Estudio EFEMAP. Risk factors for increased cost of exacerbations of chronic bronchitis and chronic obstructive pulmonary disease. *Archivos de bronconeumología, 42*(4), 175-82.

Loudon, C., Coroll, V., Butcher, J., Pawsthorne, P., & Berstein, C. (1999). The effects of physical exercise on patients with Crohn's disease. *American Journal of Gastroenterology,* 697-703.

Mallavarapu, R. & Grimsley, E.W. (2007). The history of lupus erythematosus. *Southern Medical Journal, 100*, 896-896

Manfredini, F., Malagoni, A.M., Mandini, S. Boari, B., Felisatti, M., Zamboni, P. et al. (2009), Sport Therapy for Hypertension: why, how and how much?. *Angiology, 60*, 207-16.

Mannerkorpi, K. (2005). Exercise in fibromyalgia. *Current Opinion in Rheumathology, 17,* 190-194.

Mannino, D.M., Homa, D.M., Pertowski, C.A.,Ashizawa, A., Nixon, L.L., Johnson, C.A. et al. (1998). Surveillance for asthma—United States, 1960–1995. In: CDC Surveillance Summaries, *MMWR Morbidity and Mortality Weekly Report, 47*(SS-1), 1–28.

Matsumoto, T., Nakagawa, S., Nishida, S., & Hirota, R. (1997). Bone Density and Bone Metabolic Markers in Active Collegiate Athletes: Findings in Long-Distance Runners, Judoists and Swimmers. *International journal of sports medicine, 18*, 408-12.

Minor, M. (1996). Arthritis and exercise: 'the times they are a-changin'. *Arthritis care and research, 9*, 79–81.

Minor, M.A., Hewett, J.E., Webel, R.R., Anderson, S.K., & Kay, D.R. (1989). Efficacy of physical conditioning exercise in patients with rheumatoid arthritis and osteoarthritis. *Arthritis & Rheumatism, 32,* 1396–1405.

Motl, R.W. & Gosney, J.L. (2008). Effect of exercise training on quality of life in multiple sclerosis: a meta-analysis. *Multiple Sclerosis, 14,* 129-35.

Murphy, M.H., Murtagh, E.M., Boreham, C.A., Hare, L.G., & Nevill, A.M. (2006). The effect of a worksite based walking programme on cardiovascular risk in previously sedentary civil servants. *BMC Public Health, 6*, 136.

Nakamura, Y., Tanaka, K., Shigematsu, R., Nakagaichi, M., Inoue, M., & Homma, T. (2008). Effects of aerobic training and recreational activities in patients with chronic obstructive pulmonary disease. *International journal of rehabilitation research*, *31*, 275-83.

National Institutes of Health, National Asthma Education Program. (1993). Expert panel report 2: guidelines for the diagnosis and management of asthma. Bethesda, MD: National Institutes of Health, National Heart, Lung, and Blood Institute,1–153. Available at www.nhlbi.nih. gov/guidelines/asthma/asthgdln.htm. [Accessed November 19th, 2008].

Newman, M.A., Dawes, H., van den Berg, M., Wade, D.T., Burridge, J., & Izadi, H. (2007). Can aerobic treadmill training reduce the effort of walking and fatigue in people with multiple sclerosis: a pilot study. *Multiple Sclerosis, 13,* 113-9.

Ng, V., Millard, W., Lebrun, C. & Howard, J. (2007). Low-intensity exercise improves quality of life in patients with Crohn's disease. *Clinical Journal of Sport Medicine, 17,* 384-388.

Nordin, B.E. (2009). The definition and diagnosis of osteoporosis. *Salud Publica Mex,51* Suppl 1,S132-3.

Normandin, E,A., McCusker, C., Connors, M., Vale, F., Gerardi, D., & ZuWallack, R.L. (2002). An evaluation of two approaches to exercise conditioning in pulmonary rehabilitation. *Chest, 121*, 1085-1091.

O' Sullivan, S.E. & Bell, C. (2000). The effects of exercise and training on human cardiovascular reflex control. *Journal of the Autonomic Nervous System, 81,* 16-24.

Olgiati, R. & Di Prampero P. (1986). Effects of physical exercise on adaptation to energy expenditure in multiple sclerosis. *Schweizerische medizinische Wochenschrift, 116*, 374-377

Olson, T.P., Dengel, D.R., Leon, A.S., & Schmitz, K.H. (2006). Moderate resistance training and vascular health in overweight women. *Medicine & Science in Sports & Exercise,* 38, 1558-64.

Pastva, A., Estell, K., Schoeb, T.R., Atkinson, T.P., & Schwiebert, L.M. (2004). Aerobic exercise attenuates airway inflammatory responses in a mouse model of atopic asthma. *Journal of immunology , 172*,4520-6.

Peces-Barba, G., Barberà, J.A., Agustí, A., Casanova, C., Casas, A., Izquierdo, J.L., et al. (2008). Diagnosis and management of chronic obstructive pulmonary disease: joint guidelines of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR) and the Latin American Thoracic Society (ALAT). *Archivos de Bronconeumología, 44*, 271-81.

Pescatello, L.S., Franklin, B.A., Fagard,R., Farguhar, W.B., Kelley, G.A. & Ray, C.A. (2004). American College of Sports Medicine. American College of Sports Medicine position stand. Exercise and hypertension. *Medicine & Science in Sports & Exercise,* 36, 533-53.

Plotnikoff, R.C., Courneya, K.S., Trinh, L. Karunamuni, N., & Sigal, R.J. (2008). Aerobic physical activity and resistance training: an application of the theory of planned behaviour among adults with type 2 diabetes in a random, nationale sample of Canadians. *International Journal of Behavioral Nutrition and Physical Activity, 5:61.*

Pool, A.J. & Axford, J.S. (2001). The effects of exercise on the hormonal and immune systems in rheumatoid arthritis. *Rheumatology, 40*, 610-614.

Prince, R.L., Smith, M., Dick, I.M., Price, R.I., Webb, P.G., Henderson, N.K. et al. (1991). Prevention of postmenopausal osteoporosis. A comparative study of exercise, calcium supplementation and hormone-replacement therapy. *The New England Journal of Medicine 325,* 1.189-1.195.

Rabasa-Lhoret, R., Bourque, J., Ducros, F., & Chiasson, J.L. (2001). Guidelines for premeal insuline dose reduction for post-prandial exercise of differents intensities and durations in type 1 diabetic subjects treated intensively with a basalbolus insulin regimen (ultralente-lispro). *Diabetes Care, 24*, 625-630.

Ram, F.S., Robinson, S.M., Black, P.N., & Picot, J. (2005). Physical training for asthma. *Cochrane Database Syst Rev, 9*,CD00111.

Ramalho, A.C. & Soares, S. (2008). The role of exercise in the treatment of type 1 diabetes. *Arquivos Brasileiros de Endocrinologia & Metabologia, 52*, 260-267.

Ramalho, A.C., de Lourdes Lima, M., Nunes, F., Cambuí, Z., Barbosa, G., Andrade, A. et al. (2006) The effect of resistance versus aerobic training on metabolic control in patients with type-1 diabetes mellitus. Diabetes Research and Clinical Practice , 72, 271-6.

Ries, A.L., Kaplan, R.M. & Limberg, T.M.(1995). Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in patients with chronic obstructive pulmonary disease. *Annals of internal medicine*, *122*, 823-32.

Robinson, R., Krzywicki, T., Almond, L., Al–Azzawi, F., Abrams, K., Iqbal, S. et al. (1998). Effect o a low impact exercise program on bone mineral density in Crohn's Disease: a randomized controlled trial. *Gastroenterology, 115,* 36-41.

Robling, A.G., Hinant, F.M., Burr, D.B., & Turner, C.H. (2002). Shorter, more frequent mechanical loading sessions enhance bone mass. *Medicine & Science in Sports & Exercise,* 34, 196-202.

Rosimini, C. (2003). Benefits of swim training for children and adolescents with asthma. *Journal of the American Academy of Nurse Practitioners, 15*, 247-52.

Santora, A.C. (1987). Role of nutrition and exercise in osteoporosis. *The American journal of medicine, 13,*73-79.

Schachter, C.L., Busch, A.J., Peloso, P.M., & Sheppard, M.S. (2003). Effects of short versus long bouts of aerobic exercise in sedentary women with fibromyalgia: a randomized controlled trial. *Physical Therapy, 83*, 340-358.

Sharman, J.E. & Stowasser, M. (2009) Australian association for exercise ans sports science position statement on exercise and hypertension. *Journal of Science and Medicine in Sport 12*, 252-257.

Short, C.L. (1974). The antiquity of rheumatoid arthritis. *Arthritis & Rheumatism 17*, 193-205.

Sideravičiūtė, S., Gailiūnienė, A., Visagurskienė, K, & Vizbaraite, D. (2006). The effect off log-term swimming program on body composition, aerobic capacity and blood lipids in 14-19 year aged healthy girls and girls with type 1 diabetes mellitus. *Medicina (Kaunas), 42*, 661-666.

Sigal, R.J., Kenny, G.P., Wasserman, D.H. & Castaneda-Sceppa, C. (2004). Physical activity/exercise and type 2 diabetes. *Diabetes Care, 27*, 2518-2539.

Smolen, J.S., Aletaha, D., Koeller, M., Weisman, M.H., & Emery, P. (2007). New therapies for treatment of rheumatoid arthritis. *Lancet, 370*(9602), 1861-74.

Soneneberg, A. (1990). Occupational distribution of inflammatory bowel disease among German employees. *Gut, 31*, 1037-1040.

Stenstrom, C.H. & Minor, M.A. (2003) Evidence for the benefit of aerobic and strengthening exercise in rheumatoid arthritis. *Arthritis care and research, 49*, 428-34.

Sueiro, F., Estévez, I., Ayán, C., Cancela, J.M., & Martín, V. (2008). Potential benefits of non-pharmacological therapies in fibromyalgia. *The Open Rheumatology Journal, 2*, 1-6.

Sutherland, G. & Andersen, M. (2001). Exercise and multiple sclerosis: physiological, psychological and quality of life issues. *Journal of Sports Medical Physical Fitness, 41*, 421-423

Tench, C., McCarthy, J., McCurdle, I., White, P., & D'Cruz, D.(2003). Fatigue in systemic lupus erythematosus: a randomized controlled trial of exercise. *Rheumatology (Oxford), 42*, 1050–1054.

The Cochrane Database of Systematic Reviews. Pulmonary Rehabilitation for COPD. Chrocane Library, The Cochrane collaboration. Vol(issue3) 2002.

The Pew Environmental Health Commission. (2001). Attack asthma: why America needs a public health defense system to battle environmental threats. Baltimore, MD: John Hopkins School of Public Health, Pew Environmental Health Commission. Available at http://pewenvirohealth.jhsph.edu/html/home/home.html. Accessed November 19, 2001.

Thibodeau, G.A. & Patton K.T. (2000). *Anatomia y Fisiología*. Madrid: Harcourt.

Thompson, W.G., Cook, D.A., Clark, M.M. et al. (2007). Treatment of Obesity. *Mayo Clinic proceedings*, *82* (1), 93-102.

US Department of Health and Human Services. (2000). Action against asthma: a strategic plan for the Department of Health and Human Services. Rockville, MD: US Department of Health and Human Services, Office of the Assistant Secretary for Planning and Evaluation, 2000. Available at http://aspe.hhs.gov/sp/asthma. [Accessed November 19th, 2009].

US Department of Health and Human Services. (2000). Respiratory diseases [Goal 24]. In: Healthy people 2010 (conference ed., vol II). Washington, DC: US Department of Health and Human Services, *24*,1–27.

Valencia, M., Alonso, B., Alvarez, M.J., Barrientos, M.J., Ayán, C., & Martín, V. (2009). Effects of 2 physiotherapy programs on pain perception, muscular flexibility, and illness impact in women with fibromyalgia: a pilot study. *Journal of Manipulative and Physiological Therapeutics, 32*, 84-92.

Van den Ende, C.H., Vliet Vlieland, T.P., Munneke, M., & Hazes, J.M. (1998). Dynamic exercise therapy in rheumatoid arthritis: a systematic review. *British journal of rheumatology, 37*, 677-87.

Van der Laan, L. & Goris, R.J. (1997). Sudeck's syndrome. Was Sudeck right?. *Unfallchirurg, 100*, 90-9.

Wallance, J.P. (2003). Exercise in hypertension: a clinical review. *Sports Medicine, 33* (8), 585-598.

Ward, M.J. (2004). Prevalence of physician-diagnosed systemic lupus erythematosus in the United States: results from the third national health and nutrition examination survey. *Womens Health (Larchmt), 13*, 712-718

Westby, M.D., Wade, J.P., Rangno, K.K., et al. (2000) A randomized controlled trial to evaluate the effectiveness of an exercise program in women with rheumatoid arthritis taking low dose prednisone. *The Journal of rheumatology, 27*, 1674-80.

Westerterp, K.R. & Goram, M.I. (1997). Relationship between physical activity related energy expenditure and body composition: a gender difference. *International Journal of Obesity, 21*, 184-188.

Whalen, R.T. Carter, D.R., & Steele, C.R. (1988). Influence of physical activity on the regulation of bone density. *Journal of biomechanics*, *21*, 825-37.

Woo, R. & Pi Sunyer, F.X. (1982). Effect of exercise on spontaneous calories intake in obesity. *The American journal of clinical nutrition, 36*, 470-477.

Xhardez, Y. (1995). *Vademécum de Kinesioterapia y de Reeducación Funcional*. Barcelona: El Ateneo.

Zanesco, A. & Antunes, E. (2007). Effects of exercise training on the cardiovascular system: pharmacological approaches. *Pharmacology & Therapeutics, 114,* 307-317.