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Universidad del País Vasco | Euskal Herriko Unibertsitatea

DOCTORAL THESIS

EFFECT OF AN EXERCISE PROGRAM ON THE PHYSICAL CONDITION OF INDIVIDUALS WITH CHRONIC DISORDERS

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Vitoria-Gasteiz

2016

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EFFECT OF AN EXERCISE PROGRAM ON THE PHYSICAL CONDITION OF INDIVIDUALS WITH CHRONIC DISORDERS

Doctoral thesis presented by

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Vitoria-Gasteiz, 2016

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Life is like riding a bicycle.

To keep your balance you must keep moving.

Albert Einstein

It always seems impossible until it’s done

Nelson Mandela

Esta tesis está dedicada a la memoria del Dr. Juan Luis Zunzunegi, gran defensor de la promoción de la salud a través de la actividad física y primer impulsor del programa de ejercicio en el que está basada esta tesis.

Gracias a su gran trabajo durante muchos años cientos de personas se beneficiaron de los efectos de la actividad física. Ójala este gran esfuerzo perdure en el tiempo consiguiendo una sociedad más activa y sana.

Agradecimientos al Centro de Medicina Deportiva de Mendizorrotza y en especial a Mailu por su gran compromiso en el desarrollo del programa y por ayudarme en la recogida de datos.

Eskerrak eman nahi nizkioke Gorputz eta Kirol Hezkuntza sailari tesi hau egiteko aukera emateagatik.

Bestetik, eskerrak ere Montse Otero doktoreari, tesi hau egiteko aukera luzatzen nire bizitzan ate berri bat irekitzen lagundu didalako.

Nola ez, esker bereziak urte hauetan nire zuzendari izan den Susana Gil Orozko doktoreari, bere laguntza, iritzi profesional eta animoengatik.

Azkenik, familia eta gertukoen pazientzia eta laguntza gabe tesi hau aurrera eramatea ezinezkoa zatekeen, meritua haiena.

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6MW	Six-minute walk test
ACEI	Angiotensin-converting enzyme inhibitors
ACSM	American College of Sports Medicine
AET	Aerobic training
AIT	Aerobic interval training
ARB	Angiotensin receptor blocker
BMI	Body Mass Index
BP	Blood pressure
bpm	Beats per minute
Ca	Calcium
CT	Combined training
CV	Cardiovascular
CVD	Cardiovascular disease
HbA_{1C}	Glycated haemoglobin
HR	Heart rate
INE	Instituto Nacional de Estadística
mmHg	Millimeter of mercury
MSD	Musculoskeletal disorders
NCDs	Non-communicable diseases
RT	Resistance training
SD	standard deviation
VO_{2max}	Maximal oxygen uptake
WHO	World Health Organization
WHR	Waist-hip ratio

Abstract

Non-communicable diseases are the leading cause of mortality in the world and place an important burden on the society. However, risk factors related to these diseases such insufficient physical activity could be prevented. Wide evidence supports the beneficial impact of physical activity against premature mortality and chronic diseases. Nevertheless, despite multicomponent training programs seem to be the optimal methods to attain these beneficial effects, challenges still remain in the development of effective interventions for this population.

Therefore, the main aim of this study was to evaluate and assess the characteristics of a combined exercise program aimed at improving the physical condition and at reducing risk factors of individuals with different chronic disorders such as musculoskeletal disorders, type 2 diabetes, hypertension and obesity. Weight, waist and hip circumferences, blood pressure, heart rate and cardiorespiratory fitness were measured at baseline, 3, 6 and 9 months.

Results showed clinically relevant reductions in blood pressure but not in heart rate. Changes in body composition outcomes were minor and cardiorespiratory fitness improvements were also modest although statistically significant and they could be potentially beneficial for some individuals. The improvements in flexibility observed could also be important concerning functional status. Even though changes after 9 months were greater, some variables showed significant changes already at 3 months which highlights the short-term benefits of physical activity.

The lack of effect on some of the outcome measures could have been caused by insufficient stimulus, adherence issues influenced by different barriers or other factors. Therefore, this area deserves further attention in order to develop interventions that warrant high levels of participation and adherence across all population groups in order to improve the physical condition of individuals suffering from chronic disorders.

INTRODUCTION

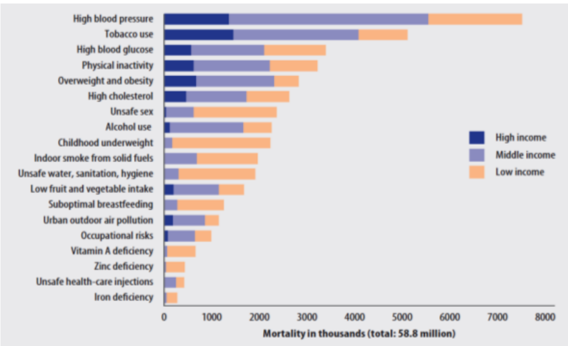
1. INTRODUCTION

1.1. The prevalence of chronic diseases

Non-communicable diseases (NCDs) are the leading cause of mortality in the world (63%). The major NCDs such as cardiovascular diseases (CVD), cancer, diabetes and chronic lung diseases are mainly caused by four behavioral risk factors: tobacco, alcohol use, unhealthy diet and insufficient physical activity, which lead to four key metabolic or physiological changes such as high blood pressure, excess body weight, high blood glucose and high cholesterol (World Health Organization [WHO], 2011).

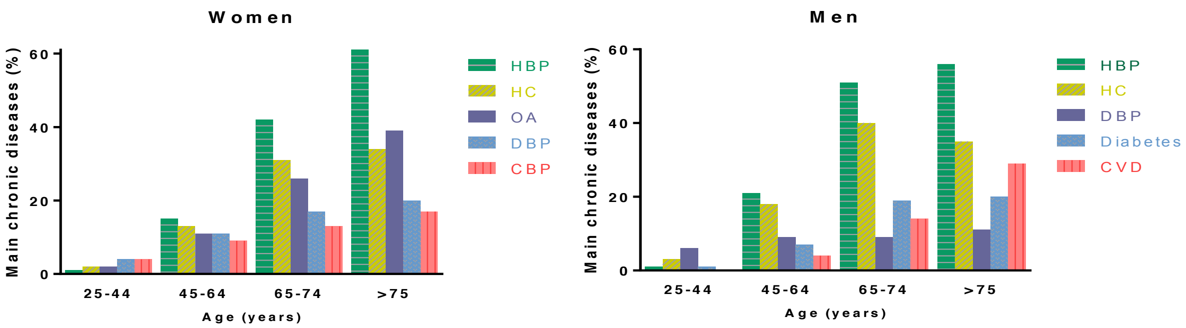
In 2009, high blood pressure (systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg) was estimated to cause 13% of all deaths worldwide and was the major risk factor for CVD (Figure 1). Tobacco use accounted for 9% of all deaths, high blood glucose for 6%, physical inactivity for 6% and overweight (Body mass index [BMI] 25-30 kg/m^2) and obesity (BMI ≥ 30 kg/m^2) accounted for 5% of all deaths (WHO, 2011).

Figure 1. Deaths attributed to 19 leading risk factors, by country income level. Source: World Health Organization, 2009



In the Basque Country, according to the health survey completed in 2013, almost half of the Basque population (47% women and 46% men) and 80% of the individuals over 65 years of age suffered from some type of chronic disease (Esnaola et al., 2013). The most common chronic diseases among the Basque population were high blood pressure (16% women and 15% men) and high cholesterol (12% women and 13% men). Back pain (6%), diabetes (5%) and CVD (5%) were the next common diseases in men and osteoarthritis (11%), dorsal back pain (9%) and cervical back pain (7%) in women (Esnaola et al., 2013). Osteoporosis affected 0.4% of the men and 4% of the women (Esnaola et al., 2013).

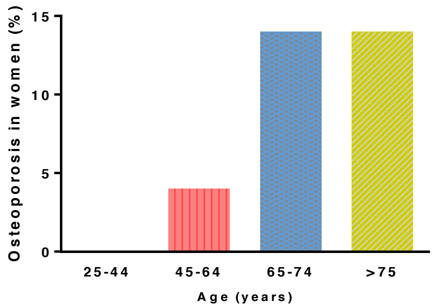
Figure 2. Prevalence of main chronic diseases in different age groups in women and men in the Basque Country.



HBP: high blood pressure, HC: high cholesterol, OA: osteoarthritis,
DBP: dorsal back pain, CBP: cervical back pain,
CVD: cardiovascular disease excluding myocardial infarction.
Source: Adapted from Gobierno Vasco, 2013a

As it can be seen in Figure 2 above, the prevalence of these diseases was considerably increased in the older age groups (Gobierno Vasco, 2013a). 42% and 61% of the women in the older age groups (65-74 years of age and over 75 years of age, respectively) suffered high blood pressure while only 15% of their younger counterparts, 45-64 years of age, were affected. Similar trends were observed in men with 51% and 56% affected in the oldest age groups and 21% in the younger 45-64 age group. High cholesterol also affected more individuals from the oldest age groups, 31% of women and 40% of men 65-74 years of age and 34% of women and 35% of men over 75. In women, osteoarthritis was also more prevalent in the older groups (26% and 39% respectively) as well as dorsal back pain (17% and 20%) and cervical back pain (13% and 17%). Similar increases as age increased were observed in osteoporotic women (Figure3), were 14% of the oldest age groups were affected and only 4% in the 45-65 age group.

Figure 3. Prevalence of osteoporosis in different age groups in women in the Basque Country.

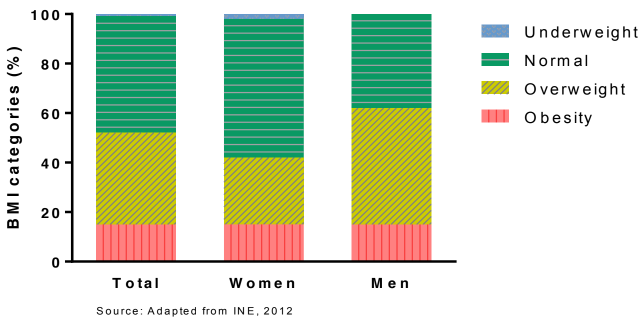


Source: Adapted from Gobierno Vasco, 2013a

In men, diabetes prevalence almost tripled from the 45-64 age group to the 65-74 group (7% vs. 19%) and CVD excluding myocardial infarction was more than three times bigger in the 65-74 age group if compared to the younger group (14% vs. 4%). Moreover, the over 75 years of age group doubled the prevalence of the 65-74 age group (29% vs. 14%) (Figure 2).

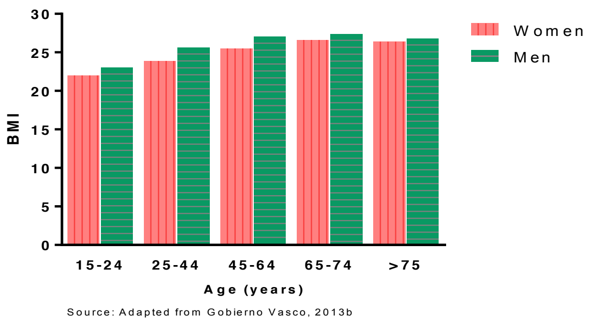
Concerning body weight (Figure 4), overweight affected more than half (52%) of the Basque population (62% of men and 42% of women), 15% of these being obese (Instituto Nacional de Estadística [INE], 2012). Even though the overall prevalence of obesity in the Basque Country had stabilized from 2007 to 2013, this prevalence increased in younger women (15-44 years of age) and in men 25-44 years of age and over 75 years of age (Esnaola et al., 2013).

Figure 4. BMI categories in women and men in the Basque Country.



As other chronic diseases, BMI also showed a tendency to increase as age increased with a trend to decrease in the oldest population (Figure 5). Men over 25 years of age and women over 45 had a mean BMI over 25 kg/m^2 (Gobierno Vasco, 2013b), which is considered overweight among international organizations (WHO, 2009).

Figure 5. BMI in different age groups in women and men in the Basque Country.



1.2. The burden of chronic diseases

The ageing of the population and an increasing prevalence of chronic diseases place a significant burden on healthcare resources (Department of Health, 2010) and also on national general income, as the loss of productivity due to inability to work weakens the economy of a country (WHO, 2011).

43% of the Basque population suffers from at least one chronic condition and 24% is affected by two or more chronic conditions (Orueta et al., 2014). In accordance with the increase of the prevalence of chronic conditions as age increases mentioned before, 66% of the individuals over 65 years of age and 76% of the individuals 80-84 years of age suffer from multimorbidity (Orueta et al., 2014). The estimations of healthcare cost in chronic patients reach 81% of the total Basque healthcare expenditure (87 % for inpatient care and 95% for prescriptions). Furthermore, individuals with multimorbidity account for 64% of total resources and those patients with five or more chronic conditions (4.3%) account for 25% of the total healthcare budget (Orueta et al., 2014). Consequently, the annual total healthcare cost per patient with one chronic condition is 637 € higher than for individuals with no conditions. The total cost for those with up to six chronic conditions is estimated in 2.303 € (Orueta et al., 2014).

Additionally, chronic diseases are responsible for 83% of disability in the Basque population. 28% of the population 65-74 years of age and 52% of the people over 75 has some kind of mobility limitation (Gobierno Vasco, 2013a), women being the most affected in the older age groups (31% in the 65-74 age group and 57% in the over 75 age group). Furthermore, 17% of the population over 70 years of age needs assistance with their personal care activities (Gobierno Vasco, 2013a).

Functional limitations and disability are mainly caused by musculoskeletal disorders (MSD) such as rheumatoid arthritis, osteoarthritis and back pain as they limit daily activities such as walking, moving around or carrying objects (Palazzo et al., 2014; Brooks, 2006; Woolf and Plfeger, 2003). Decreased physical function is associated with lower probability of being employed and lower household income, an increase in work days missed, a higher probability of receiving disability income (Dall et al., 2013) and a higher probability of early retirement (Palazzo et al., 2014) . People suffering from MSD might also need additional help from family members or health professionals, contributing to a supplementary burden apart from the direct medical expenditures and loss in productivity mentioned previously (Palazzo et al., 2014).

In 2010, 12% of the global health expenditure was estimated to be spent on diabetes, an average of $US 1330 per person a year, and these figures are expected to increase 30-34% in 2030 (Zhang et al., 2010). People with diabetes have more outpatient visits, use more medication, have a higher probability of being hospitalized and are more likely to require emergency and long-term care than people without the disease (Zhang et al., 2010). The treatment of high blood pressure also burdens the healthcare system including physician visits cost, tests, treatment-related hospitalizations and medications (Roberts and Small, 2002). Moreover, obesity accounts for between 0.7% and 2.8% of a country´s total healthcare expenditures (Withrow and Alter, 2011) and obese people had medical costs 30% greater than normal weight individuals possibly attributable to comorbidities such us hypertension, coronary heart disease or diabetes among others (Withrow and Alter, 2011).

However, the burden that NCDs place on the society could be significantly reduced, firstly, with population-based prevention interventions in order to reduce risk factors, and secondly, with improved healthcare to encourage early detection and appropriate treatments in people already affected by NCDs (WHO, 2011). NCDs and obesity related prevention measures (Cecchini et al., 2010) and healthcare interventions are believed to be cost-effective when comparing them to costly procedures that might be necessary in the detection and treatment of the advance stages of different diseases (WHO, 2011).

The economic crisis and the increase on the demand of healthcare resources caused by the ageing of the population and the increasing prevalence of chronic diseases require a modification of the healthcare system in order to respond to the new demands of the Basque society and reduce public healthcare (Departamento de Sanidad, 2012).

1.3. Physical inactivity

Physical inactivity was the fourth risk factor for NCDs and accounted for more than three million deaths in 2009 (WHO, 2009). Physical inactivity is estimated to be responsible for 6% of CVD, 7% of type 2 diabetes, 10% of cancer and 9% of premature mortality (Lee et al., 2012). In addition, inactive people have a 20-30% increased risk of all-cause of mortality (WHO, 2011).

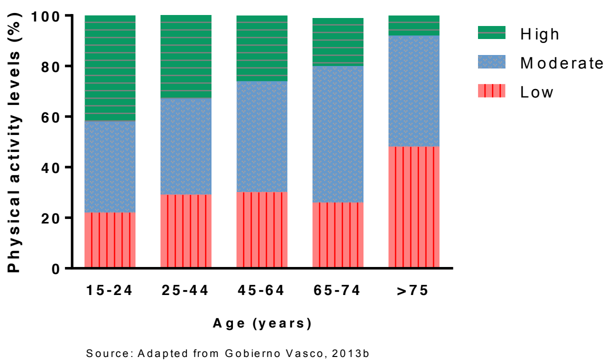
Worlwide, 31% of the adults (28% men and 34% women) are physically inactive, which means that they do not meet the criteria of 150 min of moderate intensity physical activity a week or 75 min of vigorous-intensity physical activity a week or an equivalent combination (WHO, 2010). It is also known that inactivity increases with age and that is higher in women and in high-income countries

(WHO, 2010). Emerging evidence has also associated sedentary time, defined as hours spent sitting, watching television or working at a computer, with higher metabolic risk and other harmful health outcomes independent of physical activity levels (Cooper et al., 2014). Accordingly, sedentary behavior has internationally been recognized as a public health issue (WHO, 2010). For instance, 64% of the European adults spend more than 4 hours sitting (WHO, 2010).

In the Basque Country, 31% of the population does not perform sufficient physical activity (Gobierno Vasco, 2013b). Interestingly, as it can be observed in Figure 6, these numbers are lower in the 65-74 age group (26%) if compared to the younger population from 25-64 year of age (30%). However, in the oldest age group over 75 years of age these figures rise dramatically (48%), especially in women (55%) if comparing with men (36%) (Gobierno Vasco, 2013b).

In the last years, the percentage of inactive people has decreased in men (32% in 2007 vs. 27% in 2013), barely changed in women (35% in 2007 vs. 34% in 2013) but increased in both men and women above 75 years of age (Esnaola et al., 2013).

Figure 6. Physical activity levels in different age groups in the Basque Country.



Nevertheless, as the WHO suggests, the social and economic impact of NCDs and risk factors such as physical inactivity could be prevented through cost-effective and feasible interventions (WHO, 2011). In particular, it has been estimated that a 1% relative annual reduction of risk factors such as excess weight and physical inactivity could reduce healthcare related costs by $8.5 billion in the Canadian healthcare system (Krueger et al., 2014). Even short interventions have shown reductions in primary care visits (Garriga et al., 2013).

For this reason, physical activity monitoring is considered highly important in the guidance of the development of policies and programs to increase activity levels and reduce sedentary time so as to reduce the burden of NCDs (Hallal et al., 2012).

1.4. The effect of physical activity on chronic diseases

Wide evidence supports the preventing effects of physical activity against premature mortality and chronic diseases such as CVD, stroke, hypertension, colon and breast cancer, type 2 diabetes and osteoporosis (Warbuton et al., 2010). For instance, regular physical activity could reduce the risk of ischemic heart disease by 30%, the risk of diabetes by 27% and the risk of breast and colon cancer by 21-25% (WHO, 2011). It has also been suggested that if inactivity were decreased by 10% or 25%, more than 533.000 and 1.3 million deaths respectively could be averted every year (Lee et al., 2012). Physically active individuals also have a 31% risk reduction in comparison to inactive individuals (Warbuton et al., 2010). The greatest differences in risks occur in individuals with low fitness level suggesting that sedentary people can noticeably decrease their mortality risk with small improvements in their physical activity level (Warbuton et al., 2010). Nonetheless, a dose-response relationship exists where greater health benefits are achieved with higher volumes or intensities of activity (Bayego, Vila and Martínez, 2012; Warbuton et al., 2010).

These health benefits can be achieved if current physical activity guidelines of 30 min five days per week of moderate aerobic exercise or vigorous activity for at least 20 min three days a week are met (Bayego, Vila and Martínez, 2012; Warburton et al., 2010; WHO, 2010). It is believed that the benefits of physical activity outweighs the risk of musculoskeletal injuries and cardiovascular accidents such sudden death or myocardial infarction (Bayego, Vila and Martínez, 2012). Besides, only 0.19-1.3 musculoskeletal injuries occur every 1.000 hours of exercise, one sudden death every 215.000 hours of marathon running and 18 cardiovascular events every million hours among inactive individuals (Bayego, Vila and Martínez, 2012).

1.4.1. Effect of physical activity in the disorders of the musculoskeletal system

Osteoarthritis

Osteoarthritis is characterized by a degeneration and loss of articular cartilage which causes pain, aching or stiffness (Beckwee et al., 2013). Obesity and joint injury appear to be the strongest modifiable risk factors associated with osteoarthritis (Suri, Morgenroth and Hunter, 2012).

It is well documented the ability of physical activity reducing pain and disability and improving function in individuals with knee and hip osteoarthritis (Brakke, Singh and Sullivan, 2012). Physical activity improves range of motion, balance, propioception (Beckwee et al., 2013; Semanik, Chang and Dunlop, 2012) and strength gain of the surrounding muscles can help stabilizing the affected joint (Pedersen and Saltin 2006). Reduction of body weight related to physical activity or other weight loss methods can also decrease the mechanical and inflammatory stressors that contribute to joint degeneration (Vincent et al., 2012).

Both strengthening and aerobic exercises have been shown to control pain and improve physical function in individuals with osteoarthritis (Loew et al., 2012; Semanik, Chang and Dunlop, 2012) but strengthening exercises, aquatic therapy and balance therapies appear to be the most beneficial (Brakke, Singh and Sullivan, 2012), especially those performed in supervised settings (Di Domenica et al., 2005). Physical activity prescription for these individuals is considered safe and the adverse effects such exacerbation of pain, falls or fracture happen to be minimal (Roddy et al., 2005).

Rheumatoid arthritis

Rheumatoid arthritis is a chronic inflammatory autoimmune disease that affects joints (Cairns and Veigh, 2009). Symptoms include muscle weakness, fatigue, joint pain and inflammation and subsequent restricted mobility and reduced fitness levels (Iversen, Braweman and Iversen, 2012). In addition, comorbid depression is also frequent in these patients (Bruce, 2008). Individuals with rheumatoid arthritis are twice as likely to suffer from CVD related with immune-mediated ischemic heart disease and atherosclerosis (Iversen, Braweman and Iversen, 2012). Furthermore, inactivity associated to these patients contributes to developing hypertension, obesity or other metabolic disorders (Iversen, Braweman and Iversen, 2012).

The main role of physical activity is to increase muscle strength and improve aerobic fitness in order to prevent other diseases related to inactivity (Pedersen and Saltin, 2006). Physical activity also appears to stimulate anti-inflammatory responses of the body (Pedersen and Saltin, 2006) and to positively impact mental health such depression and quality of life of these patients (Zippenfening and Sirbu, 2014).

Programs combining aerobic fitness and strength training have been suggested to be the most appropriate for patients with rheumatoid arthritis as they can improve both aerobic capacity and muscle strength necessary for physical functioning (Cairns and Veigh, 2009). A dose-response relationship exists between exercise and the impact on the immune system, with strenuous and eccentric exercise showing the greatest changes in immunologic response (Iversen, Braweman and Iversen, 2012). Adverse events or exacerbation of the disease and pain have rarely been reported (Iversen, Braweman and Iversen, 2012).

Osteoporosis

Osteoporosis is a progressive chronic bone disease characterized by low bone mass and deterioration of bone tissue that increases bone fragility and the incidence of fractures (Pigozzi et al., 2009).

Mechanical stimulus of bone tissue accelerates bone formation in normal bone and may attenuate bone loss in osteoporotic individuals (Howe et al., 2011; Schwarz, Courteix and Karlsson, 2006). Physical activity can prevent or reverse at least 1% of bone loss per year in the lumbar spine and the femoral neck of pre and post-menopausal women (Warburton et al., 2010). The increase in muscle cross-sectional area and muscle strength induced by physical activity also improves balance, potentially reducing the risk and number of falls and incidence of fractures (Warburton et al., 2010).

Taking into account that most falls are associated with modifiable factors such as weakness or unsteady gait (Rubenstein, 2006), the widely supported protective effect of physical activity against fall risk (Shubert, 2011; Kemmler et al., 2010) seems fundamental in this population with a high susceptibility to injury, as 10-20% of the falls in the elderly result in injury, hospitalization or death (Rubenstein, 2006).

Even though different types of physical activity, such as walking, have shown positive effects on bone density in older postmenopausal women (Muir et al., 2013), an extensive review by Howe et al. (2011) reported that the most effective type of exercise on bone mineral density for the neck of femur appeared to be progressive resistance strength training of the lower extremity. Resistance and agility exercises have also been suggested to reduce fall risk mediated mainly by improved postural stability and strength gain (Liu-Ambrose et al., 2004).

Fibromyalgia

Fibromyalgia is a chronic disorder that involves widespread pain, rapid fatigue, reduced muscle strength and cognitive dysfunction (Wolfe et al., 2010; Pedersen and Saltin, 2006). These symptoms affect negatively the individual´s physical functionality, mental health and quality of life (Busch et al., 2011).

Physical activity has been shown to improve functioning, reduce pain and fatigue (Busch et al., 2011) and improve mental health, quality of life and reduce the impact of the disease on the person´s daily life (Cadenas and Ruiz, 2014).

Different types of exercise such as dance, water activities, taichi, yoga, pilates, Nordic walking and general conditioning have shown improvements in pain control, physical function and psychological factors such as depression or anxiety (Cadenas and Ruiz, 2014; Busch et al., 2011). Moreover, multidisciplinary interventions that include an educational and a psychological component combined with physical activity seem to be the most beneficial in improving quality of life (Cadenas and Ruiz, 2014). Even 30 minutes of self-selected physical activity a day induces changes in perceived physical function and pain (Fontaine, Conn and Clauw, 2010).

1.4.2. Effect of physical activity in type 2 diabetes

Type 2 diabetes represents 80-90% of all diabetes and is characterized by elevated or abnormally high blood glucose levels and other metabolic disturbances due to insufficient insulin secretion and reduced insulin sensitivity (Colberg, 2012). Complications related to sustained elevated blood glucose at the macrovascular level include coronary heart disease, stroke and lower extremity ischemia, and microvascular damage such as nephropathy, retinopathy and neuropathies (O´Hagan, De Vito and Boreham, 2013; Pedersen and Saltin, 2006). The prevalence of other risk factors in diabetic individuals is also high, for instance, overweight (80%), hypertension (60-80%) and dyslipidemia (40-50%) (Pedersen and Saltin, 2006). Furthermore, CVD is the major cause of disability and mortality in diabetic individuals (Creager et al., 2003; Meigs, 2003).

Physical activity enhances insulin sensitivity and glucose uptake in the exercised muscle lowering blood glucose levels (O´Hagan, De Vito and Boreham, 2013; Pedersen and Saltin, 2006). Physical activity also has beneficial effects on body weight, fasting glucose, fasting insulin and insulin resistance, blood cholesterol, blood pressure (O´Hagan, De Vito and Boreham, 2013; Brun et al., 2008) and endothelial function (Okada et al., 2010), all these factors contributing to the normalization of CV risk in diabetics (Schreuder et al., 2014). In addition, reductions in glycated haemoglobin (HbA_{1C}), a key marker of long-term glycaemic control considered an indicator of treatment efficacy (O´Hagan, De Vito and Boreham, 2013), have also been observed, this effect not being mediated by weight loss (Sigal et al., 2006). Accordingly, reductions in risks of type 2 diabetes have been shown to be independent of BMI suggesting that physical activity can still be beneficial in the risk reduction of type 2 diabetes even if weight loss is not achieved (Jeon et al., 2007). Moreover, exercise can preserve improvement in insulin sensitivity and other metabolic parameters even during weight regain (Thomas et al., 2010).

Physical activity offers an average risk reduction of 42% in active individuals (Warbuton et al., 2010) and 2.5 hours per week of brisk walking can reduce the risk of developing diabetes by 63-69% (Laaksonen et al., 2005). The beneficial effects of physical activity in glucose metabolism may not be intensity dependent (O´Hagan, De Vito and Boreham, 2013; Colberg, 2012), which could be helpful to improve patients' adherence. Similar to other conditions, the dose-response relationship allows important reductions in risk even with small changes in activity levels (Warbuton et al., 2010; Laaksonen et al., 2005) especially in individuals at high risk (Gill and Cooper, 2008). However, more prolonged or intense activity stimulates insulin action for longer (Colberg, 2012) and those at the highest risk of developing type 2 diabetes are likely to particularly benefit from exercising at high levels (Gill and Cooper, 2008).

Both aerobic and resistance training have showed improvements in glucose control (Yang et al., 2014; Snowling and Hopkins, 2006), nonetheless, programs that combine both aerobic and resistance training have been suggested to be the most effective in attaining maximal health benefits (Schwingshackl et al., 2014; Colberg, 2012). Multi-component lifestyle interventions which include dietary intervention and both aerobic and resistance training have also been showed to improve impaired fasting glucose and glucose tolerance in addition to inducing a modest weight lost in at risk prediabetic individuals (Aguiar et al., 2014). Other types of activities such as stair climbing, cycling (Ansari, 2009), brisk walking (Jeon et al., 2007) or changes into an active lifestyle (Laaksonen et al., 2005) have also been associated with substantial reductions in risk of type 2 diabetes. Home-based programs have also shown reductions in the insulin-resistance index and in prescribed anti-diabetic drugs (Brun et al., 2008). It has been suggested that even a decrease in sedentary time alone could also reduce metabolic risk in patients with type 2 diabetes (Cooper et al., 2014).

1.4.3. Effect of physical activity in high blood pressure and heart rate

High blood pressure is defined as a systolic pressure of ≥140 mmHg or a diastolic pressure of ≥90 mmHg (Mancia et al., 2013) and is an important risk factor for CVD such as stroke, acute myocardial infaction, cardiac insufficiency and sudden death (Pedersen and Saltin, 2006). Additionally, high blood pressure is related with an increased incidence of CV and all-cause mortality (Pescatello et al., 2004). Equally, elevated resting heart rate has been associated with CVD, coronary heart disease and all-cause mortality independent of systolic blood pressure or physical activity (Cooney et al., 2010) and also independent of health status (Graham et al., 2007). In accordance, Palatini et al. (2002)

declared that a resting heart rate higher than 80 bmp could lead to an 89% increase in mortality risk if compared with individuals with lower heart rate.

Blood pressure reduction after an isolated exercise session (post-exercise hypotension) or after long-term exercise training can reach 5-7 mmHg and last for 12-22 hours depending on the duration and the intensity of exercise (Pescatello et al., 2004). Physical activity is related to risk reductions of 30-50% for cardiovascular mortality and of 20-50% for all-cause mortality (Rossi et al., 2012; Nocon et al., 2008). Moreover, 33% relative incidence reduction of CVD has been observed with regular physical activity (Warburton et al., 2010). A 20 mmHg decrease in systolic blood pressure and a 10 mmHg decrease in diastolic blood pressure have been suggested to reduce cardiovascular risk in half (Pedersen and Saltin, 2006). Interestingly, even minimal reductions of 2 mmHg in systolic and diastolic blood pressure could decrease the risk of stroke by 14% and 17% and the risk of coronary artery disease by 9% and 6% respectively (Pescatello et al., 2004).

Some of the mechanisms behind the blood pressure-lowering effect of physical activity include: decreased catecholamine levels (Pescatello et al., 2004), reduction of vascular stiffness (Havlik et al., 2005) and a reduction of vasoconstriction induced by a decreased activity of sympathetic nerve system (Manfredini et al., 2009). The increase in blood flow produced by physical activity also stimulates the endothelium derived nitric oxide production which induces muscle relaxation and vasodilation, causing a decrease in the total peripheral resistance (Manfredini et al., 2009).

Regarding heart rate, long-term aerobic exercise has been suggested to have a direct effect in the autonomic control of the heart, increasing parasympathetic activity and decreasing sympathetic activity, mechanisms that in combination induce reductions in resting heart rate (Carter, Banister and Blaber, 2003).

Even though different modalities of exercise such as aerobic training, dynamic resistance training, and combined training have shown to significantly decrease blood pressure, isometric resistance exercise has been recently suggested to offer the greatest reductions in systolic blood pressure (Cornelissen and Smart, 2013). In terms of intensity, moderate and high intensity aerobic training have been suggested to offer greater reductions if compared with low intensity aerobic training (Cornelissen and Smart, 2013; Bayego, Vila and Martínez, 2012; Warbuton et al., 2010).

1.4.4. Effect of physical activity in obesity

Obesity, defined as a BMI ≥30 kg/m^2 (WHO, 2009), is characterized by excessive fat accumulation in adipose tissue and other organs (Ahima, 2011). Obesity is associated with the incidence of multiple comorbidities including obstructive sleep apnea (Carter and Watenpaugh, 2008), cancer, osteoarthritis and increased systemic inflammation (Lavie, Milani and Ventura, 2009). It also places a large impact on CV risk factors such as insulin sensitivity, type 2 diabetes, hypertension and dyslipidemia, as well affecting negatively CV structure and function including abnormal left ventricular geometry, endothelial dysfunction, heart failure and coronary heart disease among others (Lavie, Milani and Ventura, 2009). Obesity is also related to disability, productivity decline (Ahima, 2011) and with increased death risk (Pischon et al., 2008).

In addition, abdominal obesity, measured as waist circumference or waist-hip ratio (WHO, 2008), it has also been independently associated with mortality (Guallar-Castillón et al., 2009; Pischon et al., 2008) and observed to significantly fluctuate within a narrow range of BMI (WHO, 2008).

Physical activity increases energy expenditure and stimulates lipolysis, reducing fat mass and/or increasing lean tissue mass (Pedersen and Saltin, 2006). Additionally, physical activity improves various risk factors associated with obesity that have previously been mentioned, such as hypertension, insulin resistance and dyslipidemia (Warburton et al., 2010).

Current recommendations of 150 min/week of moderate physical activity may control weight or assist on maintenance of weight-loss (Jakicic and Otto, 2005; Slentz et al., 2004). However, changes in body weight and body composition without a reduction in calorie intake seem to be minimal at this exercise volume (Fogelhom, Stallknecht and Van Baak, 2006) and intensity (Beavers et al., 2014).

Nevertheless, emerging evidence supports the belief that an increase in physical activity can reduce the risk of obesity-related comorbidities and improve risk factors related to obesity such as cardio-respiratory fitness and insulin sensitivity despite minimal or no weight loss (Fogelhom, Stallknecht and Van Baak, 2006; Jakicic and Otto, 2005). The benefits include significant increases in fat-free mass (Donnelly et al., 2009), reductions in total fat mass, abdominal fat, visceral fat and cardio-metabolic risk factors, and improvements in skeletal muscle mass and cardiorespiratory fitness (Ross and Bradshaw, 2009; Pedersen and Saltin, 2006). In the same direction, Heitmann et al. (2009) suggested that BMI is related with increased mortality in sedentary individuals but not in active individuals meaning that physical activity may modify the health risk of BMI.

Combined endurance and resistance training has been shown to be more effective in improving body composition, as the increases in lean body mass and the decreases in visceral and subcutaneous fat are greater than with endurance training alone (Schwingshack et al., 2014; Park et al., 2003). This may prove to be advantageous as abdominal fat has been suggested to be a better predictor of the development of type 2 diabetes and CVD than the total amount of fat (Ibañez et al., 2010; Fencki et al., 2006). In addition, resistance training combined with weight-loss diet has been shown to improve muscle composition (Avila et al., 2010) and diminish the muscle mass loss induced by a decreased energy intake (Ibañez et al., 2010). Furthermore, this kind of exercise also improves function in obese individuals as it facilitates the ability to lift their own body weight. This improvement could also have the potential of enhancing physical activity adherence levels (Jakicic and Otto, 2005).

1.5. Physical activity interventions to improve chronic diseases

1.5.1. Interventions to improve body composition

Obesity prevention strategies and health promotion interventions often encourage participation in physical activity (Cecchini et al., 2010). However, even though the beneficial impact of physical activity in body composition is well documented, activity type, volume and intensity of the activity remain to be determined as to clarify the most beneficial combination for weight loss and change in body composition. Therefore, in the next review, the effects of different interventions will be discussed in an attempt to elucidate some of the optimal exercise to improve body composition (Table 1).

From the interventions reviewed, five were performed in North America (Willis et al., 2012; Bateman et al., 2011; Church et al., 2010; Davidson et al., 2009; Sigal et al., 2007), four in Europe (Skrypnik et al., 2015; Paoli et al., 2013; Stefanov et al., 2013; Stensvold et al., 2010) and one in Asia (Park et al., 2003). Age of the participants ranged from 18 to 80 and two studies included only women (Skrypnik et al., 2015; Park et al., 2003) and one only men (Paoli et al., 2013). Participants were overweight or obese (BMI 25-35 kg/m^2) and in three of the studies participants were also type 2 diabetics (Church et al., 2010; Sigal et al., 2007) or individuals with metabolic syndrome (Stensvold et al., 2010).

Most of the studies compared the impact of resistance training (RT), aerobic training (AET) and combined training (CT) in body composition, except Park et al. (2003) and Skrypnik et al. (2015) that compared AET and CT only, and Stefanov et al. (2013) that compared supervised CT versus non-supervised CT. Stensvold et al. (2010) included interval training in the aerobic training arm and Paoli et al. (2013) compared high-intensity combined circuit training, low-intensity combined circuit training and AET. Most of the interventions included some kind of diet monitoring (food diary or food questionnaire) in order to control for diet induced changes, except Bateman et al. (2011) that only prescribed participants not to change their usual diet and Park et al. (2003) that did not report any sort of nutritional counseling. Four interventions did not include a control group (Skrypnik et al., 2015; Paoli et al., 2013; Willis et al., 2012; Bateman et al., 2011).

The longest interventions were nine months long (Church et al., 2010) and the shortest three months (Skrypnik et al., 2015; Paoli et al., 2013; Stensvold et al., 2010). However, most interventions were six months (Stefanov et al., 2013; Davidson et al., 2009; Sigal et al., 2007; Park et al., 2003) or eight months long (Willis et al., 2012; Bateman et al., 2011). The intervention by Sigal et al. (2007) was supervised only for the first four weeks and biweekly after that. Attendance ranged from 91% to 73.4% in supervised groups and 54.8% in the non-supervised group described by Stefanov et al. (2013). Nevertheless, some interventions did not report any kind of adherence measure (Church et al., 2010; Stensvold et al., 2010; Park et al., 2003).

In terms of body composition, most authors reported significant changes in **body weight** with AET or CT but not with RT (Willis et al., 2012; Bateman et al., 2011; Church et al., 2010; Davidson et al., 2009; Sigal et al., 2007). Between AET and CT, most of the studies showed CT to be slightly more effective in decreasing body weight than AET but these differences failed to be statistically significant between these two groups. In contrast, Stensvold et al. (2010), who used aerobic interval training in the endurance groups, did not observe significant changes in body weight in any of the groups, possibly explained by the short duration of the intervention (three months). The largest decrease in body weight in the CT group (6.4 kg) was reported by Park et al. (2003). However, changes reported by other authors ranged from -2.71 kg to -1.50 kg, suggesting that those great decreases in body weight could have been confounded by an uncontrolled decrease in calorie intake mentioned previously. In addition, high-intensity circuit training showed to be more effective decreasing body weight than low-intensity circuit training but similar to AET (Paoli et al., 2013).

Concerning **waist circumference**, some authors observed greater changes in AET and CT groups compared with RT (Willis et al., 2012; Bateman et al., 2011; Davidson et al., 2009). On the contrary, others (Church et al., 2010; Stensvold et al., 2010; Sigal et al., 2007) found that the RT group showed similar decreases if compared to other groups. The greatest decreases in waist circumference were observed by Stefanof et al. (2013) with 10 cm in the supervised CT group and 7.8 cm in the non-supervised CT group. Nonetheless, it should be noted that both groups received healthy lifestyle counseling and that each participant was provided with a low calorie customized diet which could explain the large reduction in waist circumference compared to the other studies. In most studies changes in the CT groups were slightly greater (from -7.65 cm to -1.66 cm) than the AET groups, even though these changes were not statistically significant. In contrast, Stensvold et al. (2010) reported the smallest decrease in the CT group (-0.7cm) if compared to the AET (-1.3cm) or the RT (-1.4cm). However, it is important to consider that the resistance intervention in the CT group was performed only one day a week and the aerobic part two days a week, if compared to other studies were the resistance part in the CT was performed two or three days a week and the aerobic part three days a week, which could explain smaller decreases in waist circumference.

Similar to other outcomes, **fat mass** was observed to be reduced mostly by AET and CT with slightly greater non-significant changes in the CT group (Willis et al., 2012; Church et al., 2010; Sigal et al., 2007; Park et al., 2003). However, Skrypnik et al. (2015) and Stensvold et al. (2010) found AET to reduce more fat mass than the other groups. Nevertheless, Church et al. (2010) and Stensvold et al. (2010) also found the RT to significantly reduce fat mass. Reductions in the CT groups ranged from 0.8 kg to 2.66 kg, however, Paoli et al. (2013) reported greater reductions (-5.4 kg) in the high intensity circuit training group.

Most of the studies also observed that increases in **lean body mass** were induced by either RT or CT (Skrypnik et al., 2015; Paoli et al., 2013; Willis et al., 2012; Stensvold et al., 2010; Sigal et al., 2007; Park et al., 2003). However, Church et al. (2010) observed that whereas the RT gained 0.8 kg of lean body mass, the CT did not. This could be explained by the differences in the volume of the exercise of the two groups with RT performing two sets of strength exercises three days a week and the CT group only one set of the same exercises two days a week. In contrast with these results, Stensvold et al. (2010) observed increases in lean body mass in the CT group (1.4 kg) with resistance training performed only one day a week. However, three sets of exercises were used. Surprisingly, Sigal et al. (2007) did not observed any significant reductions in lean body mass in any of the groups and Stensvold et al. (2010) did not detect significant increases in lean body mass in the RT group despite significant changes in strength. Greater increases in lean body mass were induced by high-intensity vs. low-intensity circuit training (Paoli et al., 2013). Furthermore, in many studies, the AET group showed a decrease in lean body mass (Paoli et al., 2013; Willis et al., 2012; Church et al., 2010; Sigal et al., 2007) or a non-significant increase (Skrypnik et al., 2015; Stensvold et al., 2010; Park et al., 2003).

Regarding other **metabolic outcomes**, Sigal et al. (2007) found that all groups induced improvements in glycemic control but reported significantly greater effects in the CT group than AET or RT alone. Interestingly, individuals with higher baseline HbA_{1c} showed greater improvements regardless of the training group whereas the ones with better glycemic control only attained improvements with CT. Bateman et al. (2011) also found that metabolic parameters improved in the AET and CT groups but not in the RT group. However, it should be noted that the volume of exercise on the CT group of these two studies was double than the other groups. Therefore, it could be difficult to determine if the greater effects observed were due to the additional exercise time or to the combination of aerobic and resistance training. Nevertheless, Church et al. (2010) also compared the effect of different exercise modes on HbA_{1C} while maintaining similar training durations in all groups (140 min/week) and found that only the CT group significantly improved HbA_{1C}. Similar results were observed by Davidson et al. (2009) where CT induced the greatest changes in insulin resistance whereas RT did not. Conversely, Stensvold et al. (2010) did not observed changes in HbA_{1C} in any of the groups.

In summary, CT performed three days a week showed to be the optimal training method to improve body composition reducing weight, waist circumference and fat mass and increasing lean body mass. Interestingly, high-intensity circuit training seemed to have additional impact in fat and lean body mass. Furthermore, CT showed to be also the most effective improving insulin resistance and glycemic control. Nevertheless, it is important to note that the duration of exercise in the CT group of some of the studies (Willis et al., 2012; Bateman et al., 2011; Sigal et al., 2007) was double than in the AET or RT alone. Thus, it could be difficult to determine if the additional benefits observed were accrued due to the optimal combination of both exercise modes or due to the longer duration of the intervention. Interestingly, in these studies, the CT group had similar adherence than the rest of the groups even though the exercise volume was greater, meaning that the combination of different exercises in this training method could be appealing for participants. Moreover, even though supervised interventions seem to induce greater improvements, non-supervised interventions also showed to induce significant benefits. Also, three month programs were sufficient to show significant benefits, suggesting that these kinds of programs could be attractive and cost-effective for community-based interventions aimed at overweight or obese individuals.

1.5.2. Interventions to improve blood pressure

Moderate aerobic exercise has been generally recommended for the prevention and treatment of high blood pressure. However, in recent years resistance exercise has been also been suggested as an appropriate supplementation regime. Nevertheless, some negative effects of resistance training such as central arterial compliance (Kawano et al., 2008) have questioned the appropriateness of this exercise approach. Thus, the following review will summarize some of the effects of aerobic, resistance and combined exercise on blood pressure (Table 2).

Three of the papers reviewed were performed in North America (Bateman et al., 2011; Collier et al., 2008; Sigal et al., 2007) six in Europe (Skrypnik et al., 2015; Paoli et al., 2013; Soroush et al., 2013; Stefanov et al., 2013; Cornelissen et al., 2010; Stensvold et al., 2010) and one in Asia (Nemoto et al., 2007). Age of the participants ranged from 18 to 70 years of age but in most of the studies participants were middle-aged and older adults. One study included only women (Skrypnik et al., 2015) and another one only men (Paoli et al., 2013). Participants were normotensive (systolic blood pressure <120 mmHg, diastolic blood pressure <80 mmHg) (Bateman et al., 2011; Soroush et al., 2013) pre-hypertensive (systolic blood pressure 120-140 mmHg, diastolic blood pressure 80-90 mmHg) (Paoli et al., 2013; Stefanov et al., 2013; Sigal et al., 2007) but mostly pre and stage 1 hypertensives (systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg)(Skrypnik et al., 2015; Cornelissen et al., 2010; Stensvold et al., 2010; Collier et al., 2008; Nemoto et al., 2007). Most studies only included participants who were not under hypertensive medication, except Stensvold et al. (2010) that reported the use of different hypertensive medication in some of the participants. Skrypnik et al. (2015) and Nemoto et al. (2007) did not report inclusion/exclusion criteria regarding hypertensive medication.

Three studies compared the impact of RT, AET and CT on blood pressure (Bateman et al., 2011; Stensvold et al., 2010; Sigal et al., 2007). Skrypnik et al. (2015) and Paoli et al. (2013) compared AET and CT only, Collier et al. (2008) RT and AET only and Stefanov et al. (2013) compared supervised CT versus non-supervised CT. Cornelissen et al. (2010) compared high-intensity and low-intensity AET and Soroush et al. (2013) and Nemoto et al. (2007) both performed unsupervised pedometer based walking interventions, the later one comparing moderate continuous walking and high-intensity interval walking. Stensvold et al. (2010) included interval training in the aerobic training part and Paoli et al. (2013) compared high-intensity combined circuit training, low-intensity combined circuit training and AET. Six interventions did not include a control group (Skrypnik et al., 2015; Paoli et al., 2013; Soroush et al., 2013; Bateman et al., 2011; Cornelissen et al., 2010; Collier et al., 2008).

The longest intervention was eight months long (Bateman et al., 2011) and the shortest one month (Collier et al., 2008). Most interventions ranged from three to six months (Skrypnik et al., 2015; Paoli et al., 2013; Soroush et al., 2013; Stefanov et al., 2013; Bateman et al., 2011; Cornelissen et al., 2010; Stensvold et al., 2010; Nemoto et al., 2007; Sigal et al., 2007). Attendance ranged from 99% to 73.4% in supervised groups and 54.8% in the non-supervised group described by Stefanov et al. (2013). In the non-supervised pedometer based walking interventions 40-60% of the participants did not reached the minimum targets (Soroush et al., 2013; Nemoto et al., 2007).

All studies reported significant decreases in blood pressure in all groups, except Stensvold et al. (2010), Sigal et al. (2007), Stefanov et al. (2013) in the non-supervised CT group and Bateman et al. (2011). Nevertheless, in these later studies, even though the changes did not reach statistical significance they could be of clinical importance (Pescatello et al., 2004). For instance, Bateman et al. (2011) reported reductions in the CT group of 3 mmHg in both systolic and diastolic blood pressure while AET and RT did not show reductions. In contrast, Sigal et al. (2007) found the greatest changes in the RT group (-5mmHg systolic blood pressure, -2mmHg diastolic blood pressure) whereas the CT only reduced -2 mmHg in systolic blood pressure. Stensvold et al. (2010) found the greatest changes with a trend towards statistical significance only on the AET group (-5.5 mmHg systolic blood pressure, -4.1 mmHg diastolic blood pressure). Nevertheless, other groups in this study showed considerable decreases in systolic blood pressure (-2.8mmHg in the RT group and -4.2mmHg in the CT group) whereas the CT showed increases in diastolic blood pressure. It is important to consider than some individuals in the study were under hypertensive medications which could have influenced the results.

In the studies where statistically significant reductions were found, Skrypnik et al. (2015) and Collier et al. (2008) reported comparable declines in blood pressure between different training modes. Paoli et al. (2013) on the other hand, observed that different intensities exerted different changes in blood pressure even though all training modes induced significant reductions in both systolic and diastolic blood pressure. In particular, the low-intensity circuit training group, which combined AET and RT at moderate intensity, induced greater reductions in systolic blood pressure (-11 mmHg) than the high-intensity circuit training group (-7 mmHg) or the AET group (-5 mmHg). Nemoto et al. (2007) reported significantly greater reductions in systolic blood pressure in the high-intensity interval walking group (-9 mmHg) if compared to the moderate-intensity continuous walking group (-3 mmHg). Similarly, the high-intensity AET in the intervention by Cornelissen et al. (2010) also showed higher decreases in systolic blood pressure (-6 mmHg) if compared to the low-intensity AET (-3.8 mmHg) even if these differences were not statistically significant.

Concerning diastolic blood pressure and in terms of intensity, Paoli et al. (2013) observed that high-intensity circuit training produced the greatest reductions (-6 mmHg) if compared to the other groups (2-3mmHg) and Nemoto et al. (2007) also found slightly greater changes in the high-intensity group (-5 mmHg) compared to the low intensity walking group (-2 mmHg).

Soroush et al. (2013) also described reductions after a moderate intensity pedometer based walking program in systolic (-5 mmHg) and diastolic blood pressure (-4 mmHg). It is important to note that in both walking interventions (Soroush et al., 2013; Nemoto et al., 2007) despite improvements in blood pressure, no significant improvements in cardiorespiratory fitness were reported after moderate intensity walking, possibly due to the inconsistent compliance of the participants or insufficient intensity levels. On the other hand, high-intensity interval walking, which was monitorized by accelerometry, was observed to successfully induce improvements in cardiorespiratory fitness (Nemoto et al., 2007).

Concerning other vascular changes, Stensvold et al. (2010) observed that all exercise groups (RT, AET and CT) significantly reduced endothelial function, important factor for atherosclerosis, hypertension and CVD, despite the small duration of this intervention (three months). Also, Collier et al. (2008) found that vasodilatory capacity improved in both RT and AET, these changes being greater after moderate intensity RT. However, arterial stiffness was increased in the RT group while it was decreased in the AET group. Nevertheless, the increase in arterial stiffness observed after RT it has been suggested to be compensated by the increase in blood flow (Collier et al., 2008).

In the studies were resting heart rate was measured (Skrypnik et al., 2015; Cornelissen et al., 2010; Collier et al., 2008; Nemoto et al., 2007), AET seem to induce greater decreases in resting heart rate than CT (-7.43 bpm vs. -3.41 bpm) (Skrypnik et al., 2015) and also greater than RT (-5 bpm vs. 2 bpm) (Collier et al., 2008). Concerning intensity, both low and high-intensity AET induced comparable reductions (Cornelissen et al., 2010; Nemoto et al., 2007).

In conclusion, despite the contradictory results regarding the optimal mode of exercise to improve blood pressure, it seemed that any type of exercise exerted a beneficial effect on it. Reductions in systolic blood pressure ranged from -5 mmHg to -2.8 mmHg after RT, from -7 mmHg to -0.60 mmHg after AET and from -11 mmHg to -2 mmHg after CT. Changes in diastolic blood pressure also ranged from -4.1 mmHg to -0.16 after RT, from -5.5 mmHg to -0.87 after AET and from -4 mmHg to 0.8 mmHg after CT. Interestingly, high-intensity AET was observed to induce decreases around -7.5 mmHg in systolic blood pressure and – 5 mmHg in diastolic which did not seem to differ considerably from other studies that performed AET at moderate intensities (-7 mmHg systolic and -5.5 mmHg in diastolic blood pressure) (Skrypnik et al., 2015). Nevertheless, high-intensity and low-intensity combined circuit training induced different changes in systolic and diastolic blood pressure, suggesting that the beneficial effect of exercise could be intensity dependent regardless of the exercise mode. Regarding HR, AET seemed to be the optimal exercise mode to reduce heart rate regardless of the intensity.

It is important to note that supervised programs might be more appropriate for lowering blood pressure as non-supervised programs might not reach desirable intensities to induce changes in blood pressure due to the difficulty for the individuals to control and regulate intensities on their own. Also, normotensive, pre-hypertensive and stage 1 hypertensive individuals seemed to show similar reductions in blood pressure and the length of the intervention did not seem to affect the beneficial effects of physical activity, as one month interventions showed to be as effective in lowering blood pressure and heart rate as longer interventions. These findings emphasize the beneficial short-term impact of physical activity in lowering blood pressure which is of great clinical importance especially in the management of blood pressure in advanced stages of hypertension but also as a protective measure in normotensive individuals.

1.5.3. Interventions to improve flexibility

Flexibility is a key factor for the performance of the activities of daily living (American College of Sport Medicine [ACSM], 2014; Nguyen and Cihlar, 2013). Particularly, hamstring flexibility is essential for good posture and for mobility activities such as walking, stair climbing or getting in and out of a car, in addition to preventing low-back pain and reducing the risk of falls (Rikli and Jones, 2013). High levels of flexibility have been shown to be associated with objectively assessed functional status, consequently enhancing the performance in important daily activities (Fatouros et al., 2006) and contributing to independent living (Ernsth-Bravell, Zarit and Johansson, 2011). There is conflicting evidence in regard of the optimal exercise combination to increase lower body flexibility as some have suggested that the improvements in flexibility after resistance exercise could be similar or greater than the increase produced by flexibility training alone (Fatouros et al., 2006, Swank et al., 2003). Therefore, 10 interventions aimed at improving functional fitness will be reviewed in order to clarify the optimal exercise mode to enhance lower body flexibility (Table 3).

Six of the studies reviewed were performed in Europe (Sousa et al., 2014; Sanudo et al., 2011; Carvalho, Marques and Mota, 2009; Cancela and Ayán, 2007; Fatouros et al., 2006; Kalapotharakos et al., 2005), two in Brazil (Hallage et al., 2010; Barbosa et al., 2002), one in the United States

(Villareal et al., 2011) and one in Turkey (Toraman, Erman and Agyar, 2004). Participants in all the studies were older individuals over 60 years of age. Two studies included only men (Sousa et al., 2014; Fatouros et al., 2006) and five only women (Sanudo et al., 2011; Hallage et al., 2010; Carvalho, Marques and Mota, 2009; Cancela and Ayán, 2007; Barbosa et al., 2002). Most studies included apparently healthy and sedentary participants except Sanudo et al. (2011) that included women with fibromyalgia.

Interventions included in the studies were AET and CT (Sousa et al., 2014), two CTs that included a different RT arm (Cancela and Ayán, 2007), CT (Sanudo et al., 2011; Villareal et al., 2011; Carvalho, Marques and Mota, 2009; Toraman, Erman and Agyar, 2004), AET (Hallage et al., 2010), RT (Barbosa et al., 2002) and RT at different intensities (Fatouros et al., 2006; Kalapotharakos et al., 2005). Most studies included stretching exercises in both the warm-up and cool-down phases except Sanudo et al. (2011) that included stretching only at the end of the session and Villareal et al. (2011) that included stretching exercises only at the beginning of the session. Only Sanudo et al. (2014) and Carvalho, Marques and Mota (2009) reported details regarding the stretching protocol such as number of exercises, repetitions or holding time for each stretch. Two studies did not perform stretching exercises to assess the independent effects of RT in flexibility (Fatouros et al., 2006; Barbosa et al., 2002) and one did not specify the inclusion of stretching exercise in its protocol (Hallage et al., 2010). Four studies did not include a control group (Sanudo et al., 2011; Villareal et al., 2011; Hallage et al., 2010; Cancela and Ayán, 2007).

Length of the interventions widely varied, nine months being the longest (Sousa et al., 2014), five weeks the shortest (Cancela and Ayán, 2007) and three months being the most common (Sanudo et al., 2011; Villareal et al., 2011; Hallage et al., 2010; Kalapotharakos et al., 2005). The rest of interventions were eight months (Carvalho, Marques and Mota, 2009), six months (Fatouros et al., 2006), 10 weeks (Barbosa et al., 2002) and nine weeks long (Toraman, Erman and Agyar, 2004). Attendance ranged from 82% (Sousa et al., 2014) to 100% (Villareal et al., 2011). However, three studies did not report adherence (Sanudo et al., 2011; Cancela and Ayán, 2007; Barbosa et al., 2002).

Flexibility was measured in all studies as part of a more thorough functional fitness assessment, except in Barbosa et al. (2002) were flexibility was the only outcome variable. Flexibility was mostly measured by the sit-and-reach test (Cancela and Ayán, 2007; Fatouros et al., 2006; Kalapotharakos et al, 2005; Barbosa et al., 2002) as explained by the ACSM (2014) or its modified version the chair sit-and-reach test (Sousa et al., 2014; Hallage et al., 2010; Carvalho, Marques and Mota, 2009; Toraman, Erman and Agyar, 2004) as explained by Rikli and Jones (2013). Range of movement measured by goniometry was only measured by Sanudo et al. (2011) and Villareal et al. (2011).

Results showed that all interventions induced significant improvements in lower body flexibility except Toraman, Erman and Agyar (2004). However, it is important to note that even though changes in flexibility were not statistically significant in this intervention, the effect size was large (d=1.4) after a nine week CT intervention which included five minute stretching at the beginning and at the end of the session. It is possible that the small sample size of this intervention (n=42) could have affected these results.

Sousa et al. (2014) compared the effect of AET and CT in functional fitness and observed that even though both groups performed the same flexibility exercises, the CT group attained significantly greater changes in lower body flexibility than the AET group (5.2 cm vs. 3.9 cm). This could be attributed to the additional resistance session performed once a week, suggesting a larger mechanical stimulation of the joints after RT. Nevertheless, it is important to consider that the AET group also performed 10 minutes of strengthening exercises using only body weight, apparently not sufficient to provoke the same adaptations that the ones caused by RT.

In contrast with these results, Cancela and Ayán (2007) compared two CT groups, both with an AET part performed in water. One performed a high intensity RT on machines and the other one that performed 15 minutes of calisthenics per session which included muscular endurance exercises without machines. The calisthenics groups showed greater increase in flexibility if compared to the high intensity RT one, however, these differences were not statistically significant (3.29 cm vs.1.61 cm).

Sanudo et al. (2011) also found significant improvements after a three month CT performed two days a week that included 10 minutes of stretching at the end of the session. Similarly, Villareal et al. (2011) found significant increases (9 degrees) in hamstring range of movement after a three month CT that included 15 minutes of stretching exercises at the beginning of the session performed three days a week. In the same way, Carvalho, Marques and Mota (2009) reported significant changes (4.8 cm) after eight months of CT training executed two days a week and that included five minutes of stretching in the warm-up and cool-down phases.

AET alone was also observed to significantly improve lower body flexibility (Hallage et al., 2010). Low-impact step aerobics performed three days a week for three months showed improvements of 3.8 cm in the chair sit-and-reach test. Nevertheless, the authors considered that the large increase could be explained by the participants´ low values at baseline. On the other hand, the authors did not report the execution of any stretching exercises, therefore, it is difficult to discern if the improvements in flexibility were induced by the step aerobics alone or by some stretching exercises that were not reported.

Regarding the effect of RT exercise in flexibility, Kalopotharakos et al. (2005) compared a moderate and a high intensity RT executed three days a week for three months that included five minutes of stretching in the warm-up and cool-down phases. Researchers observed that both intensities showed comparable improvements in flexibility (5 cm vs. 3.45 cm) and in other functional performance activities.

Nonetheless, as most of the CT or RT programs reviewed included stretching exercises before and/or after their program, it could be difficult to distinguish if improvements in flexibility were due to these stretching exercises or by the independent effects of resistance training induced by an increase in range of mobility when performing resistance exercises (Cancela and Ayán, 2007). For that purpose, Fatouros et al. (2006) and Barbosa et al. (2002) excluded stretching exercises from their resistance programs in order assess the independent effect of RT training in flexibility.

Fatouros et al. (2006) observed that trunk flexibility increased in all exercise groups (low, moderate and high-intensity RT) and that these increases were significantly greater in the moderate and high intensity groups (3.3 cm and 3.8 cm respectively) if compared to the low-intensity group (1.9 cm). These results are in agreement with Kalopotharakos et al. (2005) who found similar improvements between moderate and high- intensity RT. Interestingly, after the six month detraining period the moderate and high intensity groups maintained their adaptations above baseline values whereas the low-intensity group inverted the improvements (Fatouros et al., 2006). Barbosa et al. (2002) also observed similar improvements in flexibility (4 cm) after a high-intensity RT performed three days a week for 10 weeks without the presence of any stretching exercises.

The range of improvement in the chair sit-and-reach test varied from 4.8 cm (Carvalho, Marques and Mota, 2009) to almost 13 cm (Toraman, Erman and Agyar, 2004) after CT and around 3.9 cm after AET (Sousa et al., 2014; Hallage et al., 2010). In the sit-and-reach test increases ranged from 1.61 cm to 3.29 cm depending on the CT (Cancela and Ayán, 2007) and from 1.9 cm to 5 cm depending on the RT intensity (Fatouros et al., 2006; Kalopotharakos et al., 2005).

To sum up, it seems that small doses of stretching exercises either at the beginning or at the end of a training session could induce significant improvements in lower body flexibility. Moreover, these improvements could be also achieved by performing strength training alone, as resistance exercises executed through a full range of motion using agonist and antagonist muscle groups might reduce stiffness of the muscle and enhance flexibility (Fatouros et al., 2006; Barbosa et al., 2002). Both calisthenics and traditional RT training on machines showed to be appropriate in the increase of flexibility, however, moderate or high intensities seem to be more effective than lower intensities of RT in both the accrual and the maintenance of flexibility levels. Baseline physical fitness level also seems to be an important factor to consider when designing exercise protocols, as weight-bearing exercises have been shown to induce improvements in flexibility in previously sedentary individuals but not in experienced ones which might need a supplementary stimulus in order to increase flexibility and other functional outcomes (Kim et al., 2014).

1.5.4. Interventions to improve cardiorespiratory fitness

High levels of cardiorespiratory fitness are associated with reduced CV mortality and lower incidence of other risk factors such as hypertension, obesity and type 2 diabetes (Swift et al., 2013). In terms of functionality, cardiorespiratory fitness is also essential in order to perform important daily activities such as walking, stair climbing or shopping (Rikli and Jones, 2013). Moderate aerobic exercise that involves large muscle groups such walking or cycling has been recommended as the ideal mode of exercise in order to improve cardiorespiratory fitness (ACSM, 2014). Nevertheless, combined exercise and different intensities have shown similar or greater improvements. For this reason, in the following review some of the different activities to increase cardiorespiratory fitness will be discussed (Table 4).

From the 14 studies reviewed, six studies were performed in Europe (Skrypnik et al., 2015; Sousa et al., 2014; Soroush et al., 2013; Sanudo et al., 2011; Stensvold et al., 2010; Carvalho, Marques and Mota, 2009), four in the U.S.A (Willis et al., 2012; Bateman et al., 2010; Church et al., 2010; Davidson et al., 2009), two in Japan (Nemoto et al., 2007; Park et al., 2003), one in Brazil (Hallage et al., 2010), and one in Turkey (Toraman, Erman and Agyar, 2004). Most studies included middle aged and/or older individuals but some of them also included younger adults (Skrypnik et al., 2015; Soroush et al., 2013; Willis et al., 2012; Bateman et al., 2010; Church et al., 2010). Five studies included only women (Skrypnik et al., 2015; Sanudo et al., 2011; Hallage et al., 2010; Carvalho, Marques and Mota, 2009; Park et al., 2003) and one only men (Sousa et al., 2014).

Participants´ inclusion critera included sedentary and apparently healthy individuals (Sousa et al., 2014; Hallage et al., 2010; Carvalho, Marques and Mota, 2009; Nemoto et al., 2007; Toraman, Erman and Agyar, 2004), overweight or obese (Skrypnik et al., 2015; Soroush et al., 2013; Willis et al., 2012; Bateman et al., 2010; Davidson et al., 2009; Park et al., 2003), type 2 diabetics (Church et al., 2010), individuals with metabolic syndrome (Stensvold et al., 2010) or individuals with fibromyalgia (Sanudo et al., 2011).

From all the interventions reviewed, five compared the effect of RT, AET and CT in cardiorespiratory fitness (Willis et al., 2012; Bateman et al., 2010; Church et al., 2010; Stensvold et al., 2010; Davidson et al., 2009), three studies compared AET and CT (Skrypnik et al., 2015; Sousa et al., 2014; Park et al., 2003), one measured only AET (Hallage et al., 2010), three studies measured only CT (Sanudo et al., 2011; Carvalho, Marques and Mota, 2009; Toraman, Erman and Agyar, 2004) and two evaluated the effect of walking interventions in cardiorespiratory fitness (Soroush et al., 2013; Nemoto et al., 2007). Five interventions did not include a control group (Skrypnik et al., 2015; Soroush et al., 2013; Willis et al., 2012; Bateman et al., 2010; Hallage et al., 2010).

Length of interventions ranged from nine weeks (Toraman, Erman and Agyar, 2004) to nine months (Sousa et al. 2014; Church et al., 2010). Attendace varied from 77% to 91% and in the non-supervised pedometer based walking interventions (Soroush et al. 2013; Nemoto et al., 2007), 40-60% of the individuals did not reached the minimum targets, 10.000 steps and 8.000 steps respectively.

Nine studies used maximal oxygen uptake (VO_{2max}) to measure cardiorespiratory fitness (Skrypnik et al., 2015; Soroush et al., 2013; Willis et al., 2012; Bateman et al., 2011; Church et al., 2010; Stensvold et al., 2010; Davidson et al., 2009; Nemoto et al., 2007; Park et al., 2003) and six studies used the six-minute walk test (6MW) (Sousa et al., 2014; Sanudo et al., 2011; Hallage et al., 2010; Carvalho, Marques and Mota, 2009; Toraman, Erman and Agyar, 2004) as described by Rikli and Jones (2013). The 6MW has revealed high correlations with submaximal treadmill tests and has also shown to be appropriate in detecting performance improvements in both healthy individuals and in patients with CVD, diabetes or musculoskeletal disorders (Rikli and Jones, 2013).

Results showed that most interventions induced significant improvements in cardiorespiratory fitness except Soroush et al. (2013), Church et al. (2010), Davidson et al. (2009) and Carvalho, Marques and Mota (2009).

Among the interventions that compared RT, AET and CT, two observed that all exercise modes induced significant changes in cardiorespiratory fitness (Willis et al., 2012; Bateman et al., 2010). However, AET and CT produced greater changes than RT, these changes being similar between AET and CT. Similarly, Stensvold et al. (2010) described significant and similar improvements in the AET and CT groups but not in the RT group. In opposition to these results, Church et al. (2010) and Davidson et al. (2009) did not observe significant increases in cardiorespiratory fitness in any of the exercise groups even though their interventions lasted nine and six months respectively and sessions were performed 3-5 days a week. This lack of effect could be explained by an insufficient intensity of the aerobic exercise performed, considering that the prescription was more focused on volume rather than on intensity. In addition, even though patients in all interventions were sedentary, differences in general fitness could have also affected the results, with the most deconditioned individuals achieving greater improvements if compared to the fitter ones.

As previously referred, when comparing AET and CT, it was observed that both exercises modes induced similar adaptations in cardiorespiratory fitness (Skrypnik et al., 2015; Sousa et al., 2014; Park et al., 2003). Interestingly, in the interventions by Sousa et al. (2014) and Park et al. (2003), the CT group performed aerobic exercise with less frequency than the AET group (two days vs. three days in Sousa et al. (2014) and three days vs. six days in Park et al. (2003)), which could suggest that improvements in cardiorespiratory fitness could be achieved with moderate volumes (2-3 days a week) or that these additional improvements in cardiorespiratory fitness could also be attributed to resistance training. Nevertheless, it is important to note that the performance on the 6MW is dependent on aerobic endurance and also on lower limb strength (Rikli and Jones, 2013) which could explain the improvements in this test after a combined training (Sousa et al., 2014). The slight greater improvements in VO_{2max} achieved by the CT group if compared to the AET in Park et al. (2003) deserve further attention.

Other CT interventions showed controversial results. While Sanudo et al. (2011) and Toraman, Erman and Agyar (2004) observed significant improvements in cardiorespiratory fitness after relatively short interventions (three months and nine weeks respectively), Carvalho, Marques and Mota (2009) did not report significant changes after an eight month intervention. This could be explained by the low volume of sessions per week (two) or by the use of the Borg scale for controlling intensity which could have hindered the possibility of achieving an appropriate intensity. However, other interventions using the Borg scale (Sousa et al., 2014) and others performing CT two days a week (Sanudo et al., 2011) showed significant increases in cardiorespiratory fitness. As mentioned before, the relatively good baseline cardiorespiratory fitness level of participants could have impeded greater significant improvements in this intervention.

Hallage et al. (2010) also reported significant improvements in cardiorespiratory fitness after a low impact steps aerobics intervention executed three days a week for three months. Nemoto et al. (2007) also observed significant changes in cardiorespiratory fitness after a high intensity interval walking intervention performed four days a week for five months. However, the moderate continuous walking group from the same intervention did not achieve significant improvements.

These results are in accordance with Soroush et al. (2013) who did not observed significant changes after an unsupervised pedometer based walking intervention. These findings underline the importance of intensity when performing aerobic exercise.

In summary, aerobic training seems to be the optimal exercise in order to improve cardiorespiratory fitness, either performed alone or in combination with resistance training. Even though light to moderate exercise might be appropriate for deconditioned patients (ACSM, 2014) moderate to vigorous exercise performed 3-5 days a week is recommended to improve cardiorespiratory fitness in healthier individuals. Furthermore, both supervised and unsupervised protocols showed to improve cardiorespiratory fitness despite the fact that supervised interventions had better adherence (Stefanov et al., 2013).

It could be concluded that extensive evidence supports the beneficial impact of physical activity in different chronic diseases and against premature mortality. These positive effects of physical activity include improvements in body composition, which is of great importance in the prevention and management of obesity. Also, significant reductions in blood pressure and improvements in cardiorespiratory fitness offer protection for patients suffering from CVD, hypertension or metabolic disorders such as type 2 diabetes. Furthermore, individuals with diverse MSD can also benefit from physical activity as their physical function, pain and quality of life improves under its effect.

Multicomponent training protocols which combine aerobic, resistance and stretching exercises performed at moderate intensities at least three times a week seem to be the optimal method to attain these beneficial effects as it induces changes in cardiorespiratory fitness, strength and flexibility, all vital capacities for an enhanced functionality and quality of life. Nevertheless, significant improvements have been observed with smaller doses and at lower intensities, which supports the importance of the development of programs that encourage physical activity participation especially in the more deconditioned segment of the population.

These programs have the potential of reducing the number of inactive individuals and consequently decreasing the high prevalence of chronic diseases present in the Basque population. However, despite the widely recognized beneficial effects of physical activity, challenges still remain in the development of effective interventions (Conn, Valentine and Cooper, 2002).

For this purpose, a combined exercise program was developed in order to examine and assess the characteristics of a potential effective intervention aimed at improving the physical condition and the quality of life and to reduce risk factors of individuals with different chronic disorders. This physical activity monitoring and evaluation of interventions seems essential in guiding the development of policies and population-based intervention programs.

We hypothesized that after taking part in the nine month combined program participants would not only improve their physical condition but also the symptoms related with their disorder. Moreover, we also believed that these changes in time would differ among different population groups. Also, a high motivation and satisfaction with the program was expected.

Finally, this intervention is expected to serve in the expansion and design of strategies and programs to increase physical activity and reduce sedentary behavior in order to decrease the burden that ageing, chronic conditions and disability lay on our society.

Table 1. Summary of the reviewed studies on body composition

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Skrypnik et al., 2015 Poland	n= 44 obese women (BMI ≥30kg/m²) Age 18-65	**I1:** *AET*. (50-80%HR_{max}) 45 min **3days/week** **I2:** *CT*. RT (20 min) + AET (25 min 50-80%HR_{max}). **3days/week** 3 months	**-Body weight (kg)** **-BMI (kg/m²)** **-Waist circumference (cm)** **-WHR** **-Fat mass (kg)** **-Lean body mass (kg)**		AET -2.20* -0.84* -5.26* -0.02* -2.73* 0.63	CT -2.71* -0.99* -7.65* -0.04* -2.66* 0.79*		- Food intake records to assure diet unchanged. -Attendance 86.4%.
Paoli et al., 2013 Italy	n=58 healthy, sedentary men (BMI <25kg/m²) Age 55-70	**I1:** *AET***.** Cicloergom. (50%$HR_{Reserve}$) 40 min. **3days/week** **I2:** *LI- Circuit T.* 2 sets [8´ AET (50%$HR_{Reserve}$) + RT (7 ex, 15 reps)] 50 min. **3days/week** **I3:** *HI- Circuit T.* 2 sets [8´ AET (3´ 50%$HR_{Reserve}$+ 1´ 75%$_{Reserve}$) + RT (RestPauseTechnique)] 50 min. **3days/week** 3 months	**-Body weight (kg)** **-Fat mass (kg)** **-Lean body mass (kg)**		*AET* -3.2* -1.5* -1.7	*LI-CT* -2.6* -2.9* 1.1*#	*HI-CT* -3.1* ^ -5.4* # ^ 2.3*^	-Food questionnaire to control diet changes. -Same attendance in all groups.
Stefanov et al., 2013 Bulgary	n=85 sedentary, overweight (BMI ≥25kg/m²) Age 40-60	**I1:** *Supervised CT*. AET (50-75%HR_{max}). **150 min/week** + RT free weight, resistance bands, crunches. 2-3 sets, 8-14 rep. 30-60 min. **2days/week** **I2:** *Non-supervised CT* (same as supervised). **C:**Control 6 months	**-Body weight (kg)** **-BMI (kg/m²)** **-Waist circumference (cm)** **-Fat mass (kg)** **-Lean body mass (kg)** -Attendance		*CT-S* ↓* -1.6* -10* -1.8* 1.7* 73.4%	*CT-NS* ↓* -1.0* -7.8* -2.1* 2.0* 54.8%	Control ↑ - ↓* ↑ ↓	-All groups healthy lifestyle counseling and provided with low calorie diet.
Willis et al., 2012 U.S.A	n=119 sedentary, overweight/obese (BMI 25-35kg/m²) Age 18-70	**I1**: *RT*. 3 sets, 8 ex, 8-12 rep (8-12RM). **3days/week** **I2**: *AET*. (65-80%$VO_{2\ max}$). **120 min/week** **I3**: *CT*. RT+AET 8 months	**-Body weight (kg)** **-Waist circumference (cm)** **-Fat mass (kg)** **-Lean body mass (kg)** -Attendance	RT 0.83* -0.06 -0.26 1.09* # 83.6%	AET -1.76* Ŧ -1.01* Ŧ -1.66* Ŧ -0.10 89%	CT -1.63* Ŧ -1.66* Ŧ -2.44* Ŧ 0.81* # 82%		-Food diary to track changes in diet.
Bateman et al., 2011 U.S.A	n=196 sedentary, overweight/obese (BMI 25-35kg/m²) dyslipidemic Age 18-70	**I1:** *RT*. 3 sets, 8 ex, 8-12 rep (8-12RM). **3days/week** **I2:** *AET*.(65-80% $VO_{2\ max}$) **120 min/week** **I3:** *CT*. RT+AET 8 months	**-Body weight (kg)** **-Waist circumference (cm)** -Metabolic score -Attendance	RT -0.70 0.25 → 83.8%	AET -1.54 * -1.12 ↑ 91%	CT -1.90 * -2.48* Ŧ ↑* Ŧ 77.7%		-Prescription not to change diet.

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Church et al., 2010 **U.S.A**	n=262 sedentary, type2 diabetics (BMI ≥34kg/m²) Age 30-75	**I1:** *RT*. 2 sets, 9 ex. 10-12 rep. 140min/week. **3days/week** **I2:** *AET*. (50-80% VO_{2max}) 140 min/week. **3days/week** **I3:** *CT*. RT (1 set, 9 ex). **2 days/week**) + AET. **140min/week** **C:** Control. stretching and relaxation 9 months	 **-Body weight (kg)** **-Waist circumference (cm)** **-Fat mass (kg)** **-Lean body mass (kg)** -HbA_{1C}	RT -0.3 -1.9 -1.4* 0.8 →	AET -0.8 -1.5 -0.6 -0.5 Ŧ →	CT -1.5* Ŧ -2.8 -1.7* # 0 Ŧ ↓*	Control 0.4 0.7 0.1 0.1 ↑	-Diet questionnaire to assess changes. -Attendance?
Stensvold et al., 2010 **Norway**	n=43 metabolic syndrome (BMI ≥30kg/m²) Age 50.2±9.5	**I1:** *RT*. 3 sets, 80% (1RM), 8-12 rep. **3days/week** **I2:** *AIT*. Interval training on treadmill. 4 x 4 min (90-95% HR_{max}) + 3 min (70% HR_{max}). **3days/week** **I3:** *CT*. RT (**1day/week**)+ AIT (**2days/week**) **C:**Control 3 months	 **-Body weight (kg)** **-BMI (kg/m²)** **-Waist circumference (cm)** **-Fat mass (kg)** **-Lean body mass (kg)** - HbA_{1C}	RT -0.7 0.1 -1.4* -1.9* 0.9 0.03	AET -1.4 -0.4 -1.3* -2.1* 0.7 -0.25	CT 0.4 0.1 -0.7* -0.8 1.4* 0.03	Control 0.7 0.1 1.7* -0.3 1* 0.10	-Habitual lifestyle diet. Food questionnaire to assess changes. -Attendance?
Davidson et al., 2009 **U.S.A**	n=136 sedentary, abdominally obese older adults (waist-circumf. ≥102 men and ≥88 women) Age 60-80	**I1:** *RT*. 1 set,9 ex, volitional fatigue (aprox.20 min). **3days/week** **I2:** *AET*. 30 min, moderate treadmill walking (60-75% HR_{max}). **5 days/week** **I3:** *CT*. RT+AET. **3 days/week** **C:**Control 6 months	 **-Body weight (kg)** **- BMI (kg/m²)** **-Waist circumference (cm)** -Insulin resistance	RT -0.64 -0.26 -3.18* →	AET -2.77 *Ŧ -0.96* Ŧ -5.08* Ŧ ↓* Ŧ	CT -2.31*Ŧ -0.84* Ŧ -4.61* ↓* Ŧ	Control 0.28 0.10 0.28 →	-Nutrition counseling for all groups. Food diary to monitor changes. -Attendance 91% in all groups
Sigal et al., 2007 **Canada**	n=251 sedentary, type 2 diabetics (BMI ≥34kg/m²) Age 39-70	**I1:** *RT*. 2-3 sets, 7 ex, 7-9 rep (7-9RM). **3days/week** **I2:** *AET*. (60-75% HR_{max}), 15-45 min/day. **3days/week** **I3:** *CT*. RT + AET. **3days/week** **C:**Control 6 months	 **-Body weight (kg)** **-BMI (kg/m²)** **-Waist circumference (cm)** **-Fat mass (kg)** **-Lean body mass (kg)** -HbA_{1C} -Attendance	RT -1.1 -0.4 -3* -1.3 0.3 ↑* 85%	AET -2.6* -0.8* -3* -1.6* -1 ↑* 80%	CT -2.6* -0.8* -4* -1.9* -0.7 ↑* Ŧ # 86%	Control -0.3 -0.1 -1 0.2 -0.5 →	-Dietary counseling. Food diary to track changes in diet.
Park et al., 2003 **Korea/Japan**	n=30 healthy overweight women (BMI ≥25kg/m²) Age 40-45	**I1:** *AET*. (60-70%HR_{max}) 60 min/day. **6days/week** **I2:** *CT*. AET (**3days/week**) + RT (60-70% 1RM ,60 min/day, **3days/week**) **C:**Control 6 months	 **-Body weight (kg)** **-Body fat (%)** **-Lean body mass (kg)**		AET -4.7* -9.2* 0.9	CT -6.4* -10.3* 5.6*	Control 0.6 2.3 -0.4	-No diet control -Attendance? -Small sample

I: intervention groups, C: control group, RT: resistance training, AET: aerobic exercise training, CT: combined training, LI: low –intensity, HI: high intensity, S: supervised, NS: non-supervised, BMI: body max index, WHR: waist-hip ratio, HR_{max}: maximum heart rate, $HR_{Reserve}$: hear rate reserve (HR_{max} – HR_{Rest}), VO_{2max}: maximal oxygen uptake, ex: exercises, rep: repetitions, RM: maximum repetitions, HbA_{1C} : glycated hemoglobin, *pre-post significant differences ($p<0.05$), Ŧ significant differences vs. RT ($p<0.05$), # significant differences vs. AET ($p<0.05$), ^ significant differences HI-CT vs. LI-CT($p<0.05$), →: no change

Table 2. Summary of reviewed studies on blood pressure

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Skrypnik et al., 2015 Poland	n= 44 obese women Pre&stage1 hypertensive[1] Age 18-65	**I1:** *AET*. **3days/week** **I2:** *CT*. RT + AET. **3days/week** *+Details in Table 1* 3 months	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg** -HR (bmp)		AET -6.76* -5.48* -7.43*	CT -8.88* -3.94* -3.41*		- Food intake records to assure diet unchanged. -Attendance 86.4%. -Medication?
Paoli et al., 2013 Italy	n=58 healthy, sedentary men Pre- hypertensive[1] Age 55-70	**I1:** *AET***.** 40 min. **3days/week** **I2:** *LI-Circuit Training.* 50 min. **3days/week** **I3:** *HI-Circuit Training.* **3days/week** *+Details in Table 1* 3 months	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg)**		AET -5* -3*	LI-CT -11* #^ -2*	HI-CT -7* -6* # ^	-Food questionnaire to control diet changes. -Same attendance in all groups.
Soroush et al., 2013 Sweden	N=355 overweight Normotensive[1] Age 20-65	**I1:** *Walking.* 10.000 steps **daily** 6 months	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -Aerobic fitness (VO_{2max})		AET -5* -4* →			-Unsupervised, pedometer based.
Stefanov et al., 2013 Bulgary	n=85 sedentary, overweight Pre- hypertensive[1] Age 40-60	**I1:** *Supervised CT* (AET, **150 min/week** + RT. **2days/week**). **I2:** *Non-supervised CT* (same as supervised). **C:**Control *+Details in Table 1* 6 months	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -Attendance		CT-S -10.7*^ -4.8* 73.4%	CT-NS -1.8 -2.3 54.8%	Control -2.3 0.9	-All groups healthy lifestyle counseling and provided with low calorie diet. -No medication.
Bateman et al., 2011 U.S.A	n=196 sedentary, overweight/obese Normotensive[1] Age 18-70	**I1:** *RT*. 3 sets, 8 ex, 8-12 rep (8-12RM). **3days/week** **I2:** *AET*.(65-80% $VO_{2\ max}$) **120 min/week** **I3:** *CT*. RT+AET 8 months	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -Attendance	RT 2.32 -0.16 83.8%	AET -0.57 -0.87 91%	CT -3.08 -3.32* 77.7%		-Prescription not to change diet.
Cornelissen et al., 2010 Belgium	n=48 sedentary, healthy (SBP≥120 mmHg/ DBP≥80 mmHg) Age >55	**I1:** *LI-AET*. 33% $HR_{Reserve}$.50 min **3days/week** **I2:** *HI- AET*. 66% $HR_{Reserve}$. 50 min **3days/week** 2.5 months	**-Systolic BP (mmHg)** - HR (bpm)		LI-AET -3.8* -5.1*	HI-AET -6* -5.4*		-No medication. -Attendance?
Stensvold et al., 2010 Norway	n=43 metabolic syndrome	**I1:** *RT*. **3days/week** **I2:** *AIT*. **3days/week** **I3:** *CT*. RT (**1day/week**)+ AIT	**-Systolic BP (mmHg)** **-Diastolic BP (mmHg)**	RT -2.8 -1.7	AET -5.5^{T} -4.1^{T}	CT -4.2 0.8	Control 0.7 -0.6	-Habitual lifestyle diet. Food questionnaire to assess changes.

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	**Exercise groups**				
	Pre&stage1 hypertensive[1] Age 50.2±9.5	**(2days/week)** **C:**Control *+Details in Table 1* 3 months	-Endothelial function	↑*	↑*	↑*	→	-Some participants on hypertensive medication. -Attendance?
Collier et al., 2008 **U.S.A**	n=30 Pre&stage1 hypertensives Age 30-60	**I1:** *RT.*3 sets, 9 ex, 10 rep (65% 10RM). **3days/week** **I2:** *AET.* 30 min treadmill (65% VO_{2max}). **3days/week** 1 month	 **-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -HR (bpm) -Vascular conductance -Forearm blood flow -Arterial stiffness	RT -4.4* -4.1* 2* # ↑* ↑* # ↑*	AET -4.6* -3.1* -5* Ŧ ↑* ↑* ↓*			-No medication. -Attendance 99%.
Nemoto et al., 2007 **Japan**	n=246 sedentary, healthy Pre&stage1 hypertensive[1] Age 44-78	**I1:** *Moderate continuous walking.* (50% VO_{2max}). 8000 steps/day **4days/week** **I2:** *HI Interval walking*. 5 sets x [2-3 min LI walking (40% VO_{2max})+ 3 min HI walking (70-80% VO_{2max}) **4days/week** **I3:** No walking 5 months	 **-Body weight (kg)** **-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -HR (bpm) -Aerobic fitness (VO_{2max})		Mod-AET -1.2* -3* -2* -2 ↓	HI-AET -0.8* -9* ^ -5* -1.5 ↑*	Control 0.8* -1.5 -1 -2.5 ↓	-Unsupervised, pedometer based -Medication?
Sigal et al., 2007 **Canada**	n=251 sedentary, type 2 diabetics Pre- hypertensive[1] Age 39-70	**I1:** *RT.* **3days/week** **I2:** *AET.* **3days/week** **I3:** *CT.* RT + AET. **3days/week** **C:**Control *+Details in Table 1* 6 months	 **-Systolic BP (mmHg)** **-Diastolic BP (mmHg)** -Attendance	RT -5 -2 85%	AET -3 -2 80%	CT -2 0 86%	Control -4 -1	-Dietary counseling. Food diary to track changes in diet.

***1 Normotensive= SBP<120mmHg, DBP<80mmHg. Pre-Hypertensive=SBP 120-140mmHg, DBP 80-90mmHg. Stage1-Hypertensive= SBP>140mmHg, DBP>90mmHg. (Mancia et al., 2013)*, I: intervention groups, C: control group, RT: resistance training, AET: aerobic exercise training, CT: combined training, AIT: aerobic interval training, LI: low –intensity, HI: high intensity, S: supervised, NS: non-supervised, BMI: body max index, BP: blood pressure, mmHg: millimeter of mercury, HR: heart rate, bmp: beats per minute, HR_{max}: maximum heart rate, $HR_{Reserve}$: hear rate reserve (HR_{max} – HR_{Rest}), VO_{2max}: maximal oxygen uptake, ex: exercises, rep: repetitions, RM: maximum repetitions, *pre-post significant differences (p<0.05), Ŧ significant differences vs. RT (p<0.05), # significant differences vs. AET (p<0.05), ^ significant differences HI vs. LI or supervised vs. non-supervised(p<0.05), ᵀ trend towards significance, →: no change**

Table 3. Summary of reviewed studies on flexibility

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Sousa et al., 2014 Portugal	n= 59 men, healthy independent living Age 65-79	**I1:** *AET*. Moderate (Borg 12-13), 60 min. **3days/week** **I2:** *CT*. RT (3 sets, 7 ex, 8-12 reps. 65%-75% 1RM. **1 day/week**) + AET (**2days/week)** **C:**Control 9 months	**-Lower body flexibility** Chair sit-and-reach (cm) -Attendance		AET 3.9* 82%	CT 5.2*# 86%	Control -4.7	-AET strength exercises too -Stretching performed in warm-up and cool-down (5 min each)
Sanudo et al., 2011 Spain	n=30 women with fibromyalgia Age 65-79	**I1:** *CT*. RT (1 set, 8 ex, 8-10 rep, 1-3 kg)+ AET (10-15 min, 65-70% HR_{max}) + stretching (1 set, 8-9 ex, 3 reps, holding 30s each. 10 min) **2days/week** **C:**Control 3 months	**-Lower body flexibility** ROM Hip (deg)			CT ↑*	Control →	-Stretching performed at the end of the session - Attendance?
Villareal et al., 2011 U.S.A.	n= 9 obese, sedentary, moderately frail Age 65-80	**I1:** *CT*. Flexibility (15 min)+RT (1-2 sets, 9 ex, 8-12 reps, 80% 1RM, 30 min) + AET (75% HR_{max}, 30 min) + balance (15 min). **3days/week** 3 months	**-Lower body flexibility** ROM Hamstring flexion (deg)			CT 9*		-Small sample -Stretching performed at the beginning of the session -Attendance 100%
Hallage et al., 2010 Brazil/U.S.A	n= 13 healthy women Age >60	**I1:** *AET*. Low impact Step Aerobics (50-70% HR_{max}), 30-60 min **3days/week** 3 months	**-Lower body flexibility** Chair sit-and-reach (cm)		AET 3.8*			-Small sample -Maintain current habits -Attendance 85% -Stretching?
Carvalho et al., 2009 Portugal	n= 65 sedentary, healthy women Age 64-85	**I1:** *CT*. RT (1-3 sets, 8-15 reps, circuit with elastic bands and free weights, 12-16 RPE) + AET (12-14 RPE, 20-25 min)+ agility + stretching (1set, 10 ex, 3-4 reps, holding 10-30s). 60 min. **2days/week** **C:**Control 8 months	**-Lower body flexibility** Chair sit-and-reach (cm)			CT 4.8*	Control -4.2*	-Stretching performed in warm-up and cool-down (5 min each) -Attendance 91%
Cancela et al., 2007 Spain	n= 62 healthy women Age >65	**I1:** *CT1*. Water ex (45 min. **2days/week**) + RT (3 sets, 7 ex, 10 reps, 75% 1RM. **3days/week**) **I2:** CT2. Water ex (45 min. **2days/week**) + calisthenics (45 min. **3days/week**) 5 weeks	**-Lower body flexibility** Sit-and-reach (cm)			CT1 1.61*	CT2 3.29*	-High intensity strength training -High volume -Stretching performed in warm-up and cool-down (5 min each) - Attendance?

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Fatouros et al., 2006 Greece	n= 58 healthy, sedentary men Age 65-78	**I1:** *LI RT.* 2-3 sets, 10 ex, 6-10 reps 45-50% 1RM**. 3days/week** **I2:** *MI RT.* 2-3 sets, 10 ex, 6-10 reps 60-65% 1RM. **3days/week** **I3:** *HI RT.* 2-3 sets, 10 ex, 6-10 reps 80-85% 1RM. **3days/week** **C:**Control 6 months	- **Lower body flexibility** Sit-and-reach (cm)	LI RT 1.9*	MI RT 3.3*^	HI RT 3.8*^	Control -0.3	-No stretching performed -Intensity dependent improvement -Attendance 98%
Kalapotharakos et al., 2005 Greece	n= 46 healthy sedentary Age >60	**I1:** *MI RT.* 3 sets, 8 ex, 15 reps 60% 1RM. **3days/week** **I2:** *HI RT.* 3 sets, 8 ex, 8 reps 80% 1RM. **3days/week** **C:**Control 3 months	- **Lower body flexibility** Sit-and-reach (cm)		MI RT 5*	HI RT 3.45*	Control 0.05	-Stretching performed in warm-up and cool-down (5 min each) -No sig differences between ex groups -Short -Attendance 98%
Toraman et al., 2004 Turkey	n= 42 healthy sedentary Age 60-80	**I1:** *CT.* AET (50-60% $HR_{Reserve}$)+ RT (3 sets, 10 ex, 8-12 reps, 50-80% 1RM) **3days/week** **C:**Control 9 weeks	**-Lower body flexibility** Chair sit-and-reach (cm)			CT 12.98	Control 0.7	-Stretching performed in warm-up and cool-down (5 min each) -Attendance 90% -Short intervention
Barbosa et al., 2002 Brazil	n= 22 healthy, sedentary women Age 60-80	**I1:** *RT. 3*-5 sets, 8 ex, 6-15 reps, 65-85% 1RM, 85 min. **3days/week** **C:**Control 10 week	- **Lower body flexibility** Sit-and-reach (cm)	RT 4*			Control -0.7	-No stretching performed. -Attendance? -Small sample

I: intervention groups, C: control group, RT: resistance training, AET: aerobic exercise training, CT: combined training, , LI: low –intensity, MI: moderate intensity, HI: high intensity, ROM: range of movement, deg: degrees, RPE: Borg rating of perceived exertion, HR_{max}: maximum heart rate, $HR_{Reserve}$: hear rate reserve (HR_{max} – HR_{Rest}), ex: exercises, rep: repetitions, RM: maximum repetitions, *pre-post significant differences (p<0.05), Ŧ significant differences vs. RT (p<0.05), # significant differences vs. AET (p<0.05), ^ significant differences vs. LI (p<0.05), , →: no change

Table 4. Summary of reviewed studies on cardiorespiratory fitness

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Skrypnik et al., 2015 **Poland**	n= 44 obese women (BMI ≥30kg/m²) Age 18-65	**I1:** *AET*. **3days/week** **I2:** *CT*. RT + AET. **3days/week** *+Details in Table 1* 3 months	**-VO_{2max}** (ml/kg /min)		AET 3.03*	CT 3.82*		- Food intake records to assure diet unchanged. -Attendance 86.4%.
Soroush et al., 2013 **Sweden**	N=355 overweight Age 20-65	**I1:** *Walking.* 10.000 steps daily 6 months	**-VO_{2max}** (ml/kg /min)		AET →			-Unsupervised, pedometer based.
Willis et al., 2012 **U.S.A**	n=119 sedentary, overweight/obese (BMI 25-35kg/m²) Age 18-70	**I1:** *RT*. **3days/week** **I2**: *AET*. (65-80%$VO_{2\ max}$) **120 min/week** **I3**: *CT*. RT+AET *+Details in Table 1* 8 months	**-VO_{2max}** (ml/kg /min)	RT 1.26*	AET 3.43*	CT 4.25*		-Food diary to track changes in diet.
Bateman et al., 2011 **U.S.A**	n=196 sedentary, overweight/obese (BMI 25-35kg/m²) dyslipidemic Age 18-70	**I1:** *RT*. **3days/week** **I2:** *AET*. 65-80% $VO_{2\ max}$ **120 min/week** **I3:** *CT*. RT+AET *+Details in Table 1* 8 months	**-VO_{2max}** (ml/kg /min)	RT 1.23*	AET 3.33*	CT 3.67*		-Prescription not to change diet.
Church et al., 2010 **U.S.A**	n=262 sedentary, type2 diabetics (BMI ≥34kg/m²) Age 30-75	**I1:** *RT*. 140min/week. **3days/week** **I2:** *AET*. 140min/week. **3days/week** **I3:** *CT*. RT (**2 days/week**) + AET (**140min/week**) **C:**Control. stretching and relaxation *+Details in Table 1* 9 months	**-VO_{2max}** (ml/kg /min)	RT 0.0	AET 0.5	CT 1.0 Ŧ	Control -0.3	-Diet questionnaire to assess changes. -Taking medication. -Attendance?
Stensvold et al., 2010 **Norway**	n=43 metabolic syndrome (BMI ≥30kg/m²) Age 50.2±9.5	**I1:** *RT*. **3days/week** **I2:** *AIT*. Interval training on treadmill. **3days/week** **I3:** *CT*. RT (**1day/week**)+ AIT (**2days/week**) **C:**Control *+Details in Table 1* 3 months	**-VO_{2max}** (ml/kg /min)	RT 1.4	AET 4.4*	CT 3.1*	Control -1.1	-Habitual lifestyle diet. Food questionnaire to assess changes. -Attendance?

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Davidson et al., 2009 U.S.A	n=136 sedentary, abdominally obese older adults Age 60-80	**I1:** *RT*. **3days/week** **I2:** *AET*. 30 min, moderate treadmill walking. **5 days/week** **I3:** *CT*. RT+AET. **3 days/week** **C:**Control *+Details in Table 1* 6 months	**-VO$_{2max}$** (ml/kg /min)	RT 0.05	AET 0.25 Ŧ	CT 0.23 Ŧ	Control -0.10	-Nutrition counseling for all groups. Food diary to monitor changes. -Attendance 91% in all groups.
Nemoto et al., 2007 Japan	n=246 sedentary, healthy Age 44-78	**I1:** *Moderate continuous walking*. 8000 steps/day. **4days/week** **I2:** *HI Interval walking*. **4days/week** **I3:** No walking *+Details in Table 2* 5 months	**-VO$_{2max}$** (ml/min)		Mod-AET →	HI-AET ↑*^	Control ↓	-Unsupervised, pedometer based.
Park et al., 2003 Korea/Japan	n=30 healthy overweight women (BMI ≥25kg/m^2) Age 40-45	**I1:** *AET*.60 min/day. **6days/week** **I2:** *CT*. AET (**3days/week**) + RT **3days/week**) **C:**Control *+Details in Table 1* 6 months	**-VO$_{2max}$** (ml/kg /min)		AET 8.9*	CT 10.2*	Control -0.6	-No diet control. -Small sample. -Attendance?
Sousa et al., 2014 Portugal	n= 59 men, healthy independent living Age 65-79	**I1:** *AET*. Moderate (Borg 12-13), 60 min. **3days/week** **I2:** *CT*. RT (3sets, 7 ex, 8-12 reps. 65%-75% 1RM.**1 day/week**) + AET (**2days/week)** **C:**Control 9 months	**-Distance** (m) 6MW -Adherence		AET 29.5* 82%	CT 25.6* 86%	Control -19	-Continue normal medication and dietary patterns. -AET group strength exercises too.
Sanudo et al., 2011 Spain	n=30 women with fibromyalgia Age 65-79	**I1:** *CT. RT + AET* (10-15 min, 65-70% HR$_{max}$) + stretching (10 min) **2days/week** **C:**Control. Under medical treatment *+Details in Table 3* 3 months	**-Distance** (m) 6MW			CT ↑*	Control →	-Attendance?
Hallage et al., 2010 Brazil/U.S.A	n= 13 healthy women Age >60	**I1:** *AET*. Low impact Step Aerobics (50-70% HR$_{max}$), 30-60 min **3days/week** 3 months	**-Distance** (m) 6MW		AET 56.1*			-Maintain current habits. -Attendance 85% -Small sample

Reference	Participants	Intervention	Results (Pre-post intervention differences. Shown in outcome units)					Comments
			Main outcomes	Exercise groups				
Carvalho et al., 2009 Portugal	n= 65 sedentary healthy women Age 64-85	**I1:** *CT.* RT + AET (12-14 RPE, 20-25 min) + stretching and agility. 60 min. **2days/week** **C:**Control *+Details in Table 3* 8 months	**-Distance** (m) 6MW			CT 15.7	Control -28.8*	-Attendance 91%
Toraman et al., 2004 Turkey	n= 42 healthy sedentary Age 60-80	**I1:** *CT.* Stretching + AET (50-60% $HR_{Reserve)}$+ RT. **3days/week** **C:**Control *+Details in Table 3* 9 week	**-Distance** (m) 6MW			CT 63.3*	Control 0.6	-Also educational period. -Attendance 90% -Short intervention.

I: intervention groups, C: control group, RT: resistance training, AET: aerobic exercise training, CT: combined training, NA: no applicable, LI: low –intensity, HI: high intensity, BMI: body max index, 6MW: six-minute walk test, HR_{max}: maximum heart rate, $HR_{Reserve}$: hear rate reserve (HR_{max} - HR_{Rest}), VO_{2max}: maximal oxygen uptake, ex: exercises, reps: repetitions, RM: maximum repetitions, *pre-post significant differences (p<0.05), Ŧ significant differences vs. RT (p<0.05), # significant differences vs. AET (p<0.05), ^ significant differences HI vs. LI (p<0.05), ᵀ trend towards significance, →: no change

OBJECTIVES

2. OBJECTIVES

2.1. General objectives

The main objective of this research was to assess the effectiveness of a therapeutic exercise program aimed to improve the physical condition of individuals with different chronic disorders.

The main disorders included in the program were musculoskeletal disorders, type 2 diabetes, hypertension and obesity. After nine months of combined exercise sessions, changes in different physical measures were assessed.

In addition, this research performed an evaluation of the exercise program to detect strengths and areas of improvement in order to guide the design and development of future exercise programs for this specific population.

2.2. Specific objectives

- To describe the socio-demographic characteristics of the population who attended the exercise program from 2000 to 2012. Participants´ gender, age, occupation and main disorder were analyzed for this purpose.

- To assess participation and adherence to the exercise program. Therefore, number of participants per year and days assisted were examined.

- To evaluate the effect of the exercise program on different physical parameters. Changes in anthropometric measures such weight, BMI, waist circumference and waist-hip ratio, flexibility, blood pressure, heart rate and cardiorespiratory fitness were explored to this end.

- To compare the effect of the program on different population groups. To this intent, physical measures were analyzed in women and men, in different age groups and in different diagnosis groups.

- To investigate the association between changes in different physical parameters in order to establish possible dose-response relationships.

- To evaluate motivation and satisfaction of the participants towards the exercise program in order to uncover strengths and possible improvement areas. Self-designed motivation and satisfaction questionnaires were used for this aim.

METHODOLOGY

3. METHODOLOGY

The present study is a retrospective analysis and evaluation of a therapeutic exercise program performed in Vitoria-Gasteiz between 2000 and 2012 in the Sports Medicine Centre of Mendizorrotza. This program was designed to improve the physical condition and symptoms of people with different chronic disorders such as MSD, type 2 diabetes, hypertension and obesity.

3.1. Subjects

3.1.1. Inclusion criteria

Participants needed to be referred by their family doctor and assessed by the sports doctor responsible of the exercise program.

Only individuals with at least one of the following disorders or risk factors were accepted in the program:

- Type 2 diabetes (glycemia >100 mg/dl and <250 mg/dl). Only no-insulin dependents were included
- Moderate hypertension (systolic blood pressure of 160-179 mmHg and/or diastolic blood pressure of 100-109 mmHg)
- Overweight (BMI >25 kg/m^2) or moderate obesity (BMI 30-40 kg/m^2)
- Musculoskeletal disorders: participants had one of the following: spinal column problems, osteoarthritis, arthritis, osteoporosis or fibromyalgia
- Hypercholesterolemia
- Dyslipidemia
- Smoking

3.1.2. Exclusion criteria

-Absolute contraindications:

- Recent acute myocardial infarction
- Instable angina
- Important cardiac arrhythmia
- Pericarditis or acute miocarditis
- Endocarditis
- Severe aortic stenosis
- Embolism or acute pulmonary infarction
- Morbid obesity
- Severe physical handicap

-Relative contraindications:

- Ventricular conduction abnormality
- Uncontrolled hypertension
- Type I diabetes or uncontrolled type 2 diabetes
- Moderate cardiac valvular disease
- Electrolyte anomaly
- Fever
- Psychiatric disorders or inability to collaborate.

3.1.3. Group allocation and categorization

Participants were referred by their family doctor to the Sport Medicine Centre where a sports doctor performed a thorough evaluation and personal interview in order to assess any possible disease or other limitations to perform physical activity. The medical report written by the family doctor, current medication and its relationship with physical activity were also considered to allocate participants in the appropriate exercise group. Initially, participants were divided in four main exercise groups according to their main disorder: MSD, hypertension, type 2 diabetes and obesity. As number of participants increased, more specific exercise groups were created in order to cater to participants' needs. For instance, from the MSD group six other different subgroups were created according to the different disorders: spinal column disorders, osteoarthritis, osteoporosis, fibromyalgia, "MSD general", that included patients with other problems of the musculoskeletal system as knee, shoulder or other combination of problems that could not be included in the previous groups and “MSD special”, which included either younger patients with back problems or patients with rare disorders such as Parkinson, amyotrophic lateral sclerosis or different kind of paralysis as a consequence of various reasons such car accidents or strokes.

Individuals with hypertension as primary or secondary disorder were also categorized in four groups: normal, grade 1, grade 2 and grade 3 hypertension according to the European Society of Hypertension and European Society of Cardiology (Mancia et al., 2013) (Table 5).

Table 5. Definitions and classification of blood pressure levels (mmHg) by the European Society of Hypertension and European Society of Cardiology (2013 Guidelines).

Category	Systolic		Diastolic
Optimal	<120	and	<80
Normal	120–129	and/or	80–84
High normal	130–139	and/or	85–89
Grade 1 hypertension	140–159	and/or	90–99
Grade 2 hypertension	160–179	and/or	100–109
Grade 3 hypertension	≥180	and/or	≥110
Isolated systolic hypertension	≥140	and	<90

This study complies with the ethical standards of the ethics comitee of the University of the Basque Country on Research on Human subjects. Besides, it was performed according to the ethical standards of the Helsinki Declaration. Due to the design of the study written informed consent was not possible to be obtained. In anycase, participants´ identity was anonymised using numeric codes.

3.2. Intervention

The exercise program was designed with the following general and specific aims:

General:

- To improve symptoms of the different chronic disorders
- To prevent degenerative disorders and reduce risk factors
- To improve health and quality of life
- To promote healthy and active living

Specific:

- To increase participants´ knowledge about their own disorder
- To increase nutritional knowledge
- To show and teach proper and safe ways to perform physical activity
- To encourage independent participation in physical activity
- To reduce primary care visits, medication consumption and to create a therapeutic complement for primary care clinic protocols

The total length of the program was nine months, with one hour sessions performed three times a week. The sessions combined aerobic and resistance exercise and were supervised by physical activity professionals. The structure of a standard session can be seen in Table 6.

The different exercise groups followed the same standard session design but included individualized exercises according to personal needs (Appendix 1). Intensity, progression and individualization was ensured and controlled by physical activity professionals. Sessions were performed in different civic centers located around the city.

Table 6. Structure of a standard session.

	CONTENT	OBJECTIVES
WARM-UP 10-15´	**Stretching** **Mobility exercises**	-Preparation for exercise -Injury prevention
MAIN PART 30-45´	**Flexibility**	-Improve or maintain range of motion -Improve gait, balance and coordination -Decrease rigidity
	Strength	-Increase strength -Increase maximum number of repetitions -Improve maximum contraction
	Aerobic **Moderate** **(60-80% HR_{max})**	-Increase cardiorespiratory endurance -Increase caloric expenditure -Blood pressure control
	Functional activities	-Improve functional capacity for everyday life activities -Improve self-confidence -Improve quality of life
COOL-DOWN 5-10´	**Stretching** **Relaxation**	-Progressive calm down -Enhance recovery

During the exercise sessions the following criteria were considered exclusive, therefore, any kind of exercise was immediately stopped to avoid complications to the participants:

• Glycemia	>300 mg/dl	
	<100 mg/dl – extra consumption of carbohydrates	
• Hypertension	Resting :	>180 mmHg systolic, >110 mmHg diastolic
	Post-exercise:	>250 mmHg systolic, >110 mmHg diastolic
• Musculoskeletal disorders	Pain in the execution of exercises	

After patients completed the nine month program they were not able to participate again except if they had a different diagnose. Nevertheless, in order to encourage independent participation in physical activity, participants were given the option of attending an open class, were they were allowed to use the exercise room on their own. Participants were also encouraged to create walking groups and to join regular supervised exercised lessons offered by the city council.

During the program, the sports doctor conducted different seminars and workshops related with the different disorders, their relationship with physical activity and also nutritional counseling in order to promote healthy and active living. Some of the physical activity recommendations individualized by disorder can be seen in Appendix 2.

3.3. Measurements

All measurements (anthropometric measures, flexibility, blood pressure, heart rate and cardiorespiratory fitness) were performed at baseline, at three, six and nine months. All measurements were undertaken by the same trained nurse and physical activity professionals.

3.3.1. Anthropometric measures

Measurements were conducted with participants wearing light clothing and no shoes. Weight (kg) was measured to the nearest 0.1 kg (Digital SECA scale, Germany) and height (cm) to the nearest 0.5 cm (SECA stadiometer, Germany). BMI was calculated as weight (kg) per height^2 (m^2). Obesity was defined as BMI ≥30 kg/m^2, overweight as BMI 25-29.9 kg/m^2, normal weight as BMI 18.5-24.9 kg/m^2 and underweight as BMI < 18.5 kg/m^2 (WHO, 2011).

Waist circumference (cm) was measured at the level of the iliac crest and hip circumference at the maximum protuberance of the buttocks. Both were measured at the nearest 0.5 cm.

Participants were categorized in three waist circumference groups according to the risk of metabolic complications (WHO, 2008): high or substantially increased risk of metabolic complications (>88 cm in women and >102 cm in men), increased risk for metabolic complications (80-87 cm in women and 94-101 cm in men) and an optimal waist circumference (<80 cm in women and <94 cm in men).

Waist-hip ratio (WHR) was calculated as waist circumference divided by hip circumference. Values ≥0.85 cm in women and ≥0.90 cm in men were considered as substantially increased risk for metabolic complications and values below those as normal (WHO, 2008).

In the results section waist circumference was used as the preferred measure to describe abdominal obesity considering the wider availability of studies using this measure if compared to WHR and the appropriateness that some authors have expressed in the use waist circumference (Seidell et al., 2010; WHO, 2008).

3.3.2. Flexibility

The “Sit-and-reach” bench was used (EVEQUE flexibility bench, United Kingdom) to evaluate the flexibility of the extensor muscles of the trunk and the hamstrings. From seated position in the floor, the back resting in vertical position, extended legs, feet soles rested in the box and ankles flexed at 90º degrees, the participant flexed the trunk to try to reach with his or her finger tips a far as possible, maintaining the posture for two seconds. Each participant had two tries and the highest score reached was recorded.

3.3.3. Blood pressure and heart rate

Both systolic and diastolic blood pressure and heart rate were measured in seated position at rest, before the cardiorespiratory fitness test and immediately after the test. A digital electronic tensiometer (OMROM, Japan) was used to measure blood pressure and a hear rate monitor to measure heart rate (Polar, Finland).

3.3.4. Cardiorespiratory fitness

Cardiorespiratory fitness was assessed by the six-minute walk test (6MW) which consists in walking around a course covering as much distance as possible in six minutes. This test is believed to be a good indicator of aerobic endurance in young and older adults and appropriate for detecting intervention induced changes both in healthy individuals and in patients with different disorders such CVD, diabetes or fibromyalgia (Rikli and Jones, 2013).

3.3.5. Motivation and satisfaction

A motivation questionnaire specially designed for the program (Appendix 3) was used to evaluate participants´ enjoyment towards physical activity, general opinion of the program (instructors, facilities, and other participants), self-confidence, social support, motivation to assist to the sessions and credibility on the method.

A satisfaction questionnaire specially designed for the program (Appendix 3) was also used to evaluate changes induced by the program in self-esteem, functionality and the ability to control their disorder, general expectations on the program, safety and general satisfaction with the individual attention offered.

Motivation and satisfaction were measured at the end of the program, at nine months.

3.4. Data analysis

Data analysis was performed using IBM Statistical Package for Social Sciences (SPSS- 21.0). The normal distribution of the variables was tested using the Kolmogorov-Smirnov test. Most variables did not have a normal distribution, thus, *non-parametric* tests were used for analysis. In all cases statistical significance was set at $p<0.05$.

3.4.1. Socio-demographic characteristics and diagnosis of participants and differences among groups

Socio-demographic variables such as gender, age and occupation and diagnosis were used to describe the sample. Age was described using the mean and standard deviation (SD) and was also transformed into a categorical variable by grouping participants into age decades (21-30, 31-40….81-90).

Categorical variables were described using the number of participants (n) and proportion of participants over the total (%).

Comparisons of the socio-demographic characteristics and diagnosis between women and men, among different age decades and among different diagnosis groups were performed using the *Chi Square test*. *Fisher´s Exact test* was used when the expected count in a cell was below five.

As a post-hoc test, standardized residuals were calculated in order to determine which cells contributed to the significant *Chi Square test* results.

3.4.2. Participation and adherence

Descriptive statistics were used to describe participation and adherence of participants in the program. Number of participants, number of dropouts, percentage of different dropout causes and number of injury consultations were reported for every year of the program.

Participation in the program was described by number of terms participated (one, two or three) and adherence by days assisted (n) and average assistance (%).

Categorical variables were described using the number of participants (n) and proportion of patients over the total (%).

Differences in participation and adherence among groups were compared using the *Mann-Whitney test* (two groups) and the *Kruskall-Wallis test* (more than 2 groups) for continuous variables.

3.4.3. Baseline physical measures and differences among groups

Baseline physical measures were described using the mean and standard deviation (SD) for continuous variables. BMI categories (obese, overweight, normal and underweight) and waist circumference categories (high or substantially increased risk, increased risk and optimal) were described using the proportion of participants over the total (%).

Differences in baseline physical measures among groups were compared using the *Mann-Whitney test* (two groups) and the *Kruskall-Wallis test* (more than 2 groups) for continuous variables, and the *Chi Square test* for categorical variables.

Analysis among different diagnose groups were also divided by gender considering the differences observed between men and women. This procedure was not possible to be performed with some of the variables among different age groups due to the small sample size of many of the subgroups.

Post-hoc analysis to follow-up significant *Kruskal-Wallis test*, were performed using pairwise comparisons as shown in the model viewer. In the cases were these pairwise comparisons showed no significant differences even though the original *Kruskal-Wallis test* showed to be significant, the *Mann-Whitney test* was performed to further assess pairwise significant differences.

3.4.4. Changes in physical measures and differences among groups

Changes in physical measures along the program (baseline, three months, six months and nine months) were analyzed using Friedman*´s ANOVA*. *Wilcoxon´s signed rank test* was used to follow-up significant ANOVAs, performing pairwise comparison between baseline measurements and measurements at three, six and nine months.

Effect size was measured by *Cohen´s d* in order to assess if changes from baseline to the different follow-ups were large (0.8), medium (0.5) or small (0.2) (Field, 2013).

Changes in physical measures were also analyzed by gender, age and diagnose using the same statistical tests. Changes in physical measures in different diagnose groups were also divided by gender considering the differences observed between men and women. This procedure was not possible to be performed with the different age groups due to the small sample size of many of the groups. Tests could not be performed in the 81-90 age group and in some of the physical measures in other age groups due to the null or low sample size ($n \leq 1$).

3.4.5. Association between changes in physical measures

In order to analyze the association between different physical measures, firstly, the percentage change occurred between baseline and nine months was calculated for each variable using the following formula: D=[(T2-T1)/T1]*100, where T1 stands for baseline values and T2 for values at nine months.

Secondly, bivariate correlations of these percentage changes were performed using *Spearman´s correlation coefficient* (r_s). These coefficients lie between -1 and +1, values closer to -1 showing a negative association, values closer to +1 a positive association and values closer to 0 showing no association. Also, 95% confidence intervals (CI) for these coefficients were calculated and reported in square brackets.

RESULTS

4. RESULTS

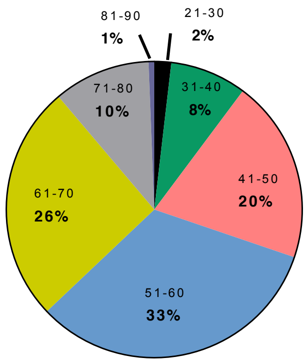
4.1. Description of the sample

4.1.1. Socio-demographic characteristics and diagnosis of the total sample

A total of 3492 patients attended the first visit to the sports doctor, referred by their family doctor, and from these, 79% (n=2760) decided to start the program. Socio-demographic characteristics of the participants such as gender, age, occupation and diagnosis are summarized in Table 7. 77.4% of the participants (n=2137) were women and 22.6% (n=623) men and their mean age was 56.12 ± 11.63. The youngest participant was 21 years of age and the oldest 89.

As can be seen in Figure 7, almost 70% of the participants were above 50 years of age, the 51-60 decade being the largest age group (33%). The main occupation of the participants was housework (34.8%) and 20.2% of them were retired.

Figure 7. Age distribution of participants. Values are shown in percentages (%).

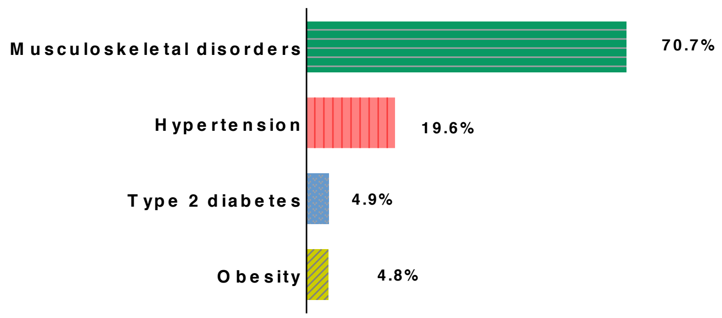


The most common primary disorder among the participants was MSD (n=1952), followed by hypertension (n=541), type 2 diabetes (n=135) and obesity (n=132) (Table 7 and Figure 8).

Table 7. Socio-demographic characteristics of participants. Values are shown in number of individuals (n) and in percentages(%).

	Total n	n	%
Gender	2760		
Women		2137	77.4
Men		623	22.6
Age (years)	2760		
21-30		51	1.8
31-40		231	8.4
41-50		552	20.0
51-60		903	32.7
61-70		714	25.9
71-80		292	10.6
81-90		17	0.6
Occupation	2283		
Retired		461	20.2
Housework		795	34.8
Disability		25	1.1
Student		4	0.2
Unemployed		24	1.1
Directors, managers		1	0.0
Scientific, intellectual professionals		128	5.6
Technical/diploma professionals		110	4.8
Administrative personnel		174	7.6
Services, commercial sector		152	6.7
Farmers, fishermen		6	0.3
Skilled workers		137	6.0
Facility, machine operators		68	3.0
Elementary occupations		196	8.6
Religious		2	0.1
Diagnosis	2760		
Musculoskeletal system disorders		1952	70.7
Type 2 diabetes		135	4.9
Hypertension		541	19.6
Obesity		132	4.8

Figure 8. Participants' main diagnosis. Values are shown in percentages (%).



In the MSD group (n=1952), 91% of the individuals had some type of MSD alone, 5% had also hypertension as secondary disorder and 3% were also obese (Figure 9). Regarding the type of MSD, almost half of them (47%) had spinal column problems, 17% osteoarthritis, 8% fibromyalgia and 2% osteoporosis. 6% of the participants were in the "MSD general" group and 18% in the "MSD special" group (Figure 10). As previously explained, participants in the "MSD general" group had other problems of the musculoskeletal system as knee, shoulder or other combination of problems that could not be included in the previous groups and the ones in the "MSD special" group were either younger patients with back problems or patients with rare disorders such as Parkinson, amyotrophic lateral sclerosis or different kinds of paralysis as a consequence of various reasons such car accidents or strokes.

Figure 9. Distribution of secondary disorders in the MSD group. Values are shown in percentages (%).

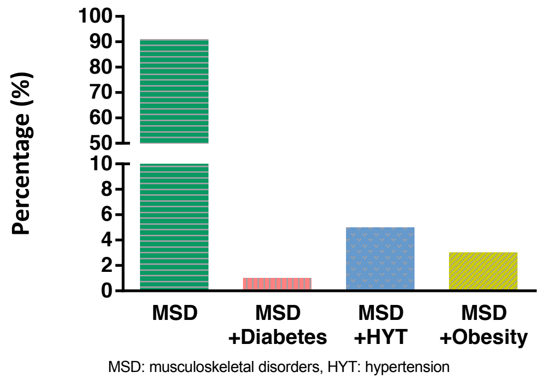
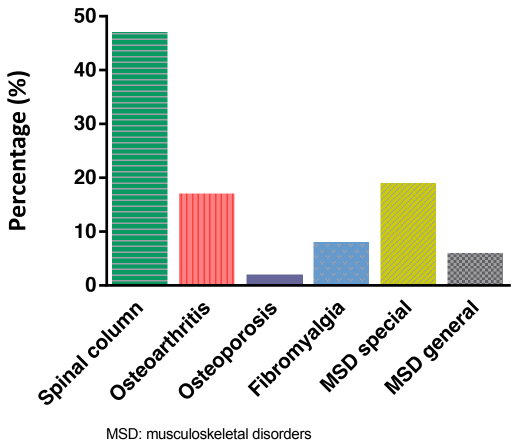
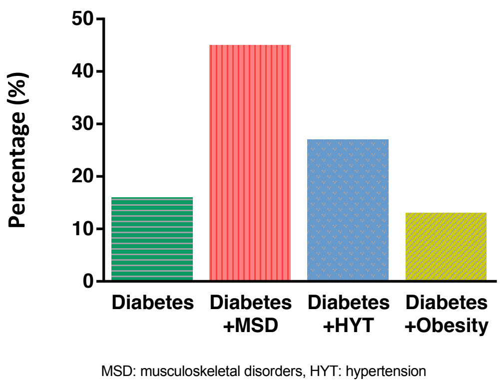


Figure 10. Distribution of different disorders among the MSD group. Values are shown in percentages (%).



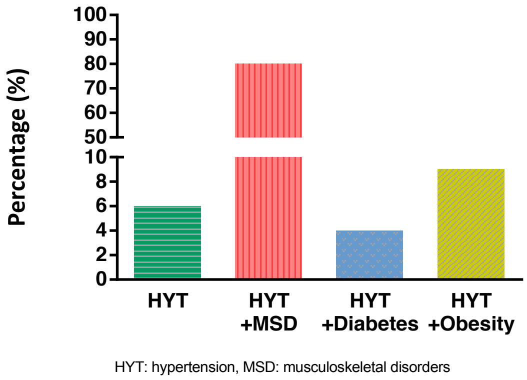
In the diabetes group (n=135), only 16% of the participants had diabetes alone, 45% had diabetes and some type of MSD as a secondary disorder (13% spinal column problems and 11% osteoarthritis), 27% had hypertension (13% of these also some kind of MSD) and 13% were obese apart from diabetic (Figure 11).

Figure 11. Distribution of secondary disorders in the diabetes group. Values are shown in percentages (%).



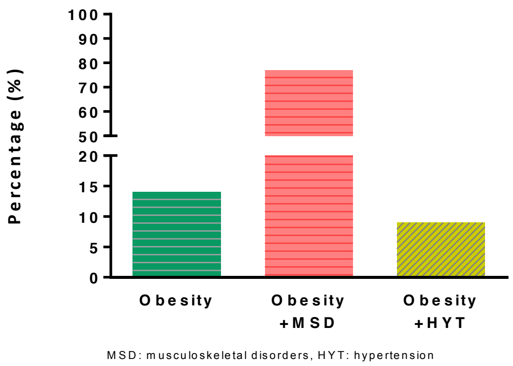
Among the hypertension group (n=541), 6% of the individuals had hypertension alone, 80% had some kind of MSD as a secondary disorder (20% osteoarthritis and 30% spinal column problems), 4% were diabetic and 9% were obese (Figure 12).

Figure 12. Distribution of secondary disorders in the hypertension group. Values are shown in percentages (%).



On the obesity group (n=132), 14% were obese alone, 77% had some kind of MSD (19% osteoarthritis and 30% spinal column problems) and 9% had hypertension (Figure 13).

Figure 13. Distribution of secondary disorders in the obesity group. Values are shown in percentages (%).



4.1.2. Socio-demographic and diagnosis differences among groups

4.1.2.1. Socio-demographic and diagnosis differences by gender

As mentioned before, 77.4% of the participants were women and the 22.6% were men. There were no significant differences in age between the two groups. However, significant differences (X^2 (14) =595.29, p <0.001) were found between men and women concerning their occupation. As seen in Table 8, 40.1% of the men were retired, 15.9% were skilled workers, 8.4% were facility or machine operators and 0.2% were taking care of the housework. On the other hand, only 14.1% of the women were retired as their only "occupation" and 45.4% were housewives. Fewer women also occupied positions as skilled workers (3%) and operators (1.3%).

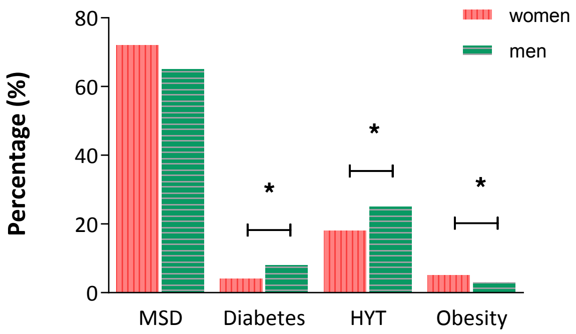
When looking at the diagnosis of the sample by gender, some significant differences (p<0.001) were found between women and men. As can be seen in Figure 14, the most common primary disorder among women was MSD (72%), followed by hypertension (18%), obesity (5%) and diabetes (4%). Among men, the prevalence of obesity (3%) was significantly lower than in women, and hypertension (25%) and diabetes (8%) higher than in women (X^2 (3) =32.27, p<0.001).

Table 8. Occupation by gender. Values are shown in number of participants (n) and percentages (%).

Occupation	Women		Men		
	n	%	n	%	sig
Retired	246	14.1	215	40.1	**
Housework	794	45.4	1	0.2	**
Disability	14	0.8	11	2.1	
Student	2	0.1	2	0.4	
Unemployed	15	0.9	9	1.7	
Directors, managers	1	0.1	0	0.0	
Scientific, intelectual professionals	85	4.9	43	8.0	
Technical/diploma professionals	85	4.9	25	4.7	
Administrative personnel	137	7.8	37	6.9	
Services, commercial sector	123	7.0	29	5.4	
Farmers, fishermen	2	0.1	4	0.7	
Skilled worker	52	3.0	85	15.9	**
Facility, machine operators	23	1.3	45	8.4	**
Elementary occupations	166	9.5	30	5.6	
Religious	2	0.1	0	0.0	

Sig: significant differences, ** (p<0.05)

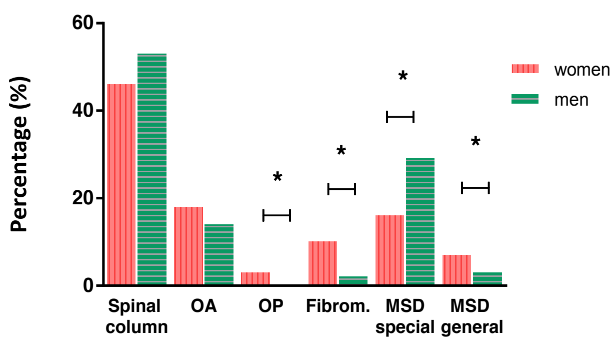
Figure 14. Differences in diagnosis by gender. Values are shown in percentages (%).



*significant differences (p<0.05), MSD: musculoeskeletal disorders,
HYT: hypertension

In the MSD group, no significant differences were found between women and men regarding their secondary disorder. However, significant differences were found in the MSD subgroups (X^2 (5) =85.83, p<0.001) (Figure 15). Significantly more men (29%) were included in the MSD special groups comparing to women (16%). 3% of women had osteoporosis whereas none of the men were included in this group. Regarding fibromyalgia, significantly more women (10%) suffered from this disorder comparing with men (2%). In the general MSD group, there were significantly fewer men (3%) than women (7%).

Figure 15. Differences in distribution of different MSD disorders between women and men. Values are shown in percentages (%).



*significant differences (p<0.05), OA: osteoarthritis, OP: osteoporosis,
Fibrom.: fibromyalgia, MSD: musculoskeletal disorders

In the hypertension group, significantly more men (9%) than women (5%) had hypertension alone and significantly more men (7%) than women (3%) had also diabetes as a secondary disorder.

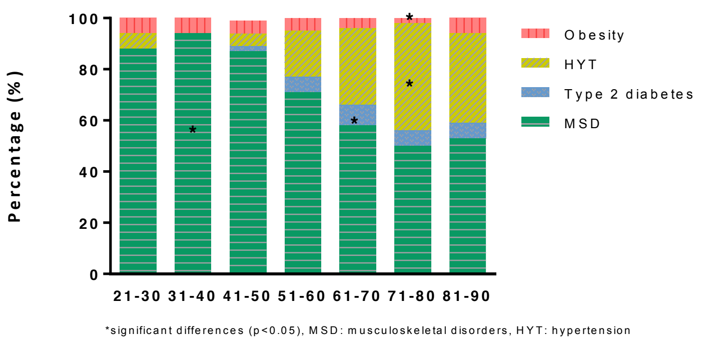
Regarding the diabetes and obesity groups, no significant differences in secondary disorder subgroups between women and men were found. Similarly, no significant differences in systolic and diastolic BP categories were found between women and men.

4.1.2.2. Socio-demographic and diagnosis differences by age

Occupation was significantly different among age groups ($X^2(84) = 1327.87$, $p<0.001$). Significantly more individuals in the oldest groups (61-70, 71-80 and 81-90) were retired and more individuals in the 51-60, 61-70 and 71-80 groups took care of housework if compared to the other groups. Scientific or intellectual professionals and administrative personnel were more predominant in the younger groups (21-30, 31-40 and 41-50). Skilled workers and facility or machine operators were also more predominant on the youngest groups (21-30 and 31-40), service or commercial workers on the 31-40 and 41-50 groups and elementary occupations on the 31-40, 41-50 and 51-60 groups. Individuals with disability were mainly in the 51-60 group and unemployed individuals in the 31-40 group.

The prevalence of the primary diseases also varied significantly (X^2 $(18) = 339.14$, $p<0.001$) among age groups. MSD were highest (94%) in the 31-40 age group, type 2 diabetes in the 61-70 age group (8%), hypertension in the 71-80 age group (42%) and obesity had similar distribution (4-6%) in almost all age groups except in the 71-80 age group that was significantly lower (2%) (Figure 16).

Figure 16. Differences in distribution of the different primary disorders among age groups. Values are shown in percentages (%).



In the MSD group, the 61-70 age group was found to have significantly higher percentage (32.5%)of individuals with hypertension as a secondary disorder than the rest of the age groups (X^2 (18)=32.1, p=.021). In addition, significant differences were also found among MSD subgroups (X^2 (30)=776.41, p<0.001) (see Table 9). The 21-30, 31-40 and 41-50 age groups had significantly more patients in the MSD special group (89%, 64% and 26% respectively). The 51-60 age group also had significantly more patients in the spinal column group (56%) and the 61-70 and the 71-80 age groups had significantly more patients in the osteoarthritis group than the rest of the groups.

Table 9. Distribution of MSD subgroups among age groups. Values are shown in number of participants (n) and percentages (%).

	Spinal Column		**Osteoarthritis**		**Osteoporosis**		**Fibromyalgia**		**MSD special**		**MSD general**	
Age	n	%	n	%	n	%	n	%	n	%	n	%
21-30	3	7%	0	0%	0	0%	1	2%	40	**89%**	1	2%
31-40	53	25%	6	3%	1	1%	14	7%	138	**64%**	4	2%
41-50	253	53%	26	5%	3	1%	53	11%	126	**26%**	21	4%
51-60	359	**56%**	127	20%	12	2%	55	9%	36	6%	52	8%
61-70	200	49%	115	**28%**	18	4%	30	7%	21	5%	28	7%
71-80	50	34%	63	**43%**	12	8%	9	6%	2	1%	11	8%
81-90	3	33%	3	33%	1	11%	0	0%	1	11%	1	11%

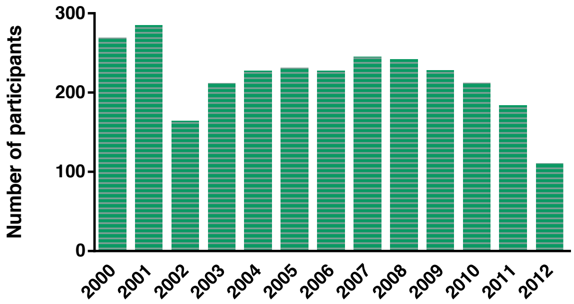
MSD: musculoskeletal disorders

In the hypertension group, the 51-60 age group had significantly more patients in the Hypertension+Obesity group (59%) if compared with the rest of age groups (X^2 (18) =47.89, p<0.001). No significant differences were found among age groups in the diabetes and obesity secondary disorders or in blood pressure categories.

4.2. Participation and adherence

The number of participants that assisted in the program can be seen in Figure 17. Average number of participants per year was n=236, the greatest number of participants n=285 (in 2001) and the lowest n=111 (in 2012).

Figure 17. Number of participants attending the program along the years. Values are shown in number of



participants(n).

The number of dropouts and the main reported causes for dropping out can be seen in Figure 18. The average number of dropouts per year was n=100, with the highest number of dropouts being n=138 (in 2004) and the lowest n=30 (in 2012). The main reasons for dropping out were personal issues (33-59%), followed by illness (2-34%). Low assistance was also an important reason to exclude participants from the program (2-27%).

The number of injury consultations can be seen in Figure 19. The average injury consultations per year was n=60, the highest number of injury consultations n=106 (in 2001) and the lowest n=12 (in 2011).

From all the participants (n= 2760), 46% (n=1251) completed the nine month program (21% of these (n=575), did it without the summer break in between, from October to June). 31% of the participants (n=849) completed one term (three months) and 23% (n=655) completed two terms (Figure 20). The mean number of days attended were 51 out of a total of 67 days and average assistance was 73%. However, participants that completed the whole program (three terms) had significantly higher average assistance (76%) than the ones that participated only one term (68%), $H(4)=23.78$, $p<0.001$. Men also had higher average assistance than women, 75% vs. 72% ($U=666.903$, $p<0.001$). As can be seen in Figure 21, as age increased the average assistance also increased significantly ($H(6)=193.098$ $p<0.001$). Patients from the hypertension group also had higher average assistance (77%) than the MSD (72%) and the obesity group (70%), $H(3)=38.01$ $p<0.001$.

Figure 18. Number of dropouts and main reasons for dropping out along the program. Values are shown in number of dropouts and percentages (%).

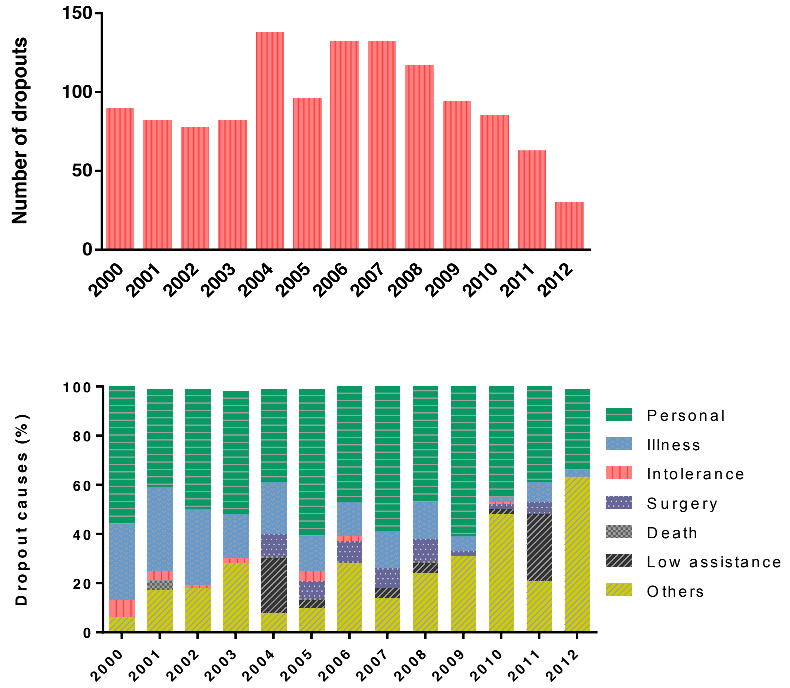


Figure 19. Number of injury consultations along the program. Values are shown in number of consultations.

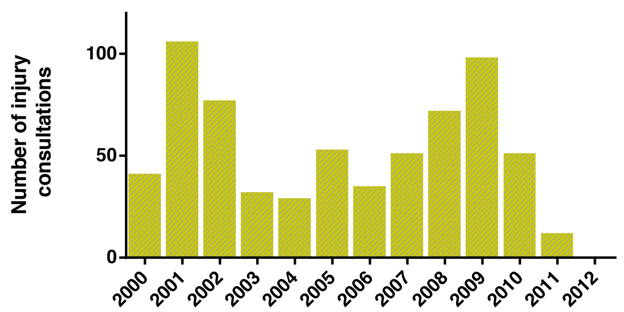
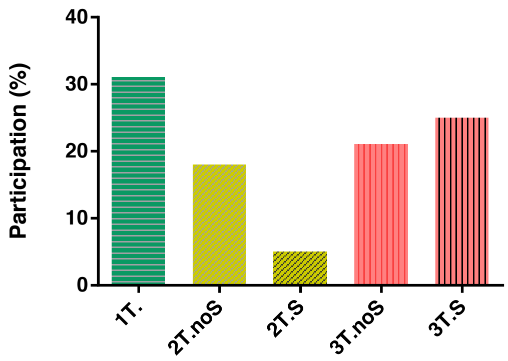
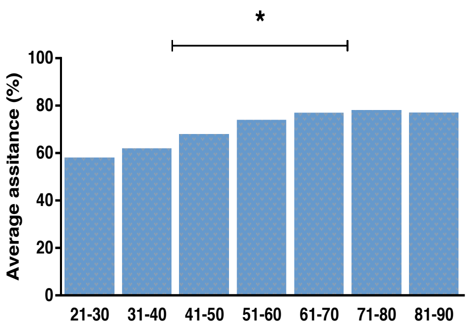


Figure 20. Participation in the program. Number of terms attended without and with the summer in between. Values are shown in percentages (%).



T: terms, noS: without the summer in between, S: with the summer in between

Figure 21. Differences in average assistance among age groups. Values are shown in percentages (%).



*significant differences ($p<0.05$)

4.3. Baseline physical measures

4.3.1. Baseline physical measures of the total sample

Physical measures of the participants at baseline are shown in Table 10.

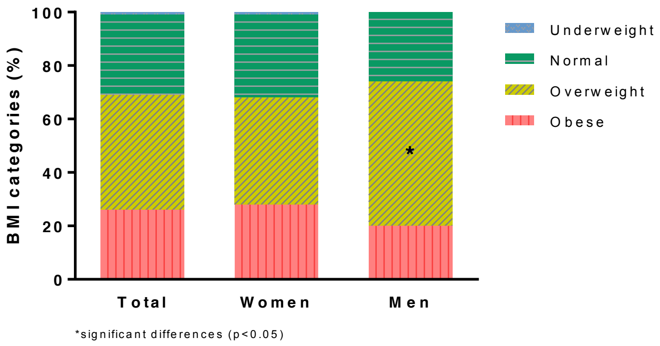
Table 10. Baseline physical measures. Values are shown in mean values and standard deviation (SD).

	n	Mean	SD
Height (cm)	2441	160.01	90.06
Weight (kg)	2538	70.82	12.99
BMI (kg/m^2)	2347	27.58	4.76
Waist circumference (cm)	211	98.39	12.30
Waist-hip ratio	200	0.91	0.08
Flexibility (cm)	1552	11.51	9.39
Resting systolic BP (mmHg)	601	146.41	14.66
Resting diastolic BP (mmHg)	601	84.52	7.63
After-exercise systolic BP (mmHg)	563	144.96	16.25
After-exercise diastolic BP (mmHg)	563	83.38	8.78
Resting HR (bpm)	315	76.03	12.91
After-exercise HR (bpm)	316	97.35	17.61
Total distance in 6MW (m)	309	472.89	65.31

n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute

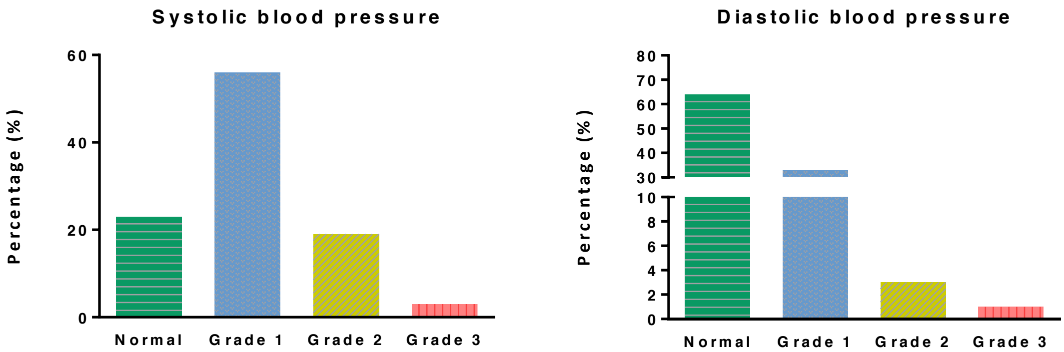
Mean BMI of the sample was 27.58±4.76 kg/m^2 and as it can be seen on Figure 17, 43% of the total sample was overweight (BMI 25-30 kg/m^2), 26% obese (BMI ≥30 kg/m^2) and 1% underweight (BMI<18.5 kg/m^2). According to the cut-off points suggested by the WHO (2008), 71% of the sample had a waist circumference that could substantially contribute to an increased risk of metabolic complications (>88 cm in women and >102 cm in men), 18% had a waist circumference that could contribute to an increased risk for metabolic complications (80-87 cm in women and 94-101 cm in men) and 11% had an optimal waist circumference (<80 cm in women and <94 cm in men) (Figure 22).

Figure 22. BMI categories in total sample, women and men. Values are shown in percentages (%).



Among all the patients with hypertension as a primary or secondary disorder (n=601), 23% had normal or controlled systolic blood pressure, 56% had grade 1 systolic hypertension, 19% grade 2 systolic hypertension and 3% had grade 3 systolic hypertension (see Figure 8). Regarding diastolic blood pressure, 64% had normal or controlled diastolic blood pressure, 33% grade 1 hypertension and 3% had grade 2 hypertension (Figure 23).

Figure 23. Categories for systolic and diastolic blood pressure. Values are shown in percentages (%).



4.3.2. Baseline physical measures by group

4.3.2.1. Baseline physical measures by gender

When looking at the baseline physical measures by gender, results showed significant differences ($p<0.05$) between women and men in height, weight (but not in BMI), waist circumference, WHR, flexibility, resting and after-exercise heart rate and total distance in the 6MW(Table 11).

Men were significantly ($p<0.001$) taller (170.81±7.42 vs. 157±6.84 cm) and heavier than women (79.78±11.74 vs. 68.22±12.16 kg) but both had similar BMI (27.36±3.86 and 27.64±5 kg/m^2 respectively). Women were significantly ($p<0.001$) more flexible (12.2±9.28 vs. 8.5±9.35 cm), had a smaller waist circumference (95.62±11.90 vs. 104.75±10.86 cm) and smaller WHR comparing to men (0.88 vs. 0.99). Men also had significantly lower resting heart reate (71.97±14.71 vs. 77.63±11.77 bpm, $p<0.001$), lower after-exercise heart rate (92.84±18.55 vs. 99.14±16.94 bpm, $p=0.01$), and covered a higher total distance on the 6MW (491.91±71.75 vs. 465.2±61.03 m, $p<0.001$).

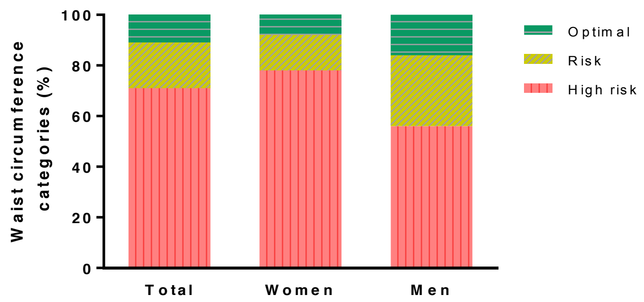
Significantly more men were overweight (54%) if compared to women (40%) (X^2 (3)=31.13, $p<0.001$) but both groups had similar amount of obese subjects (20% vs. 28%) (Figure 22). No significant differences were found in waist circumference categories between women and men but both groups showed a large number of individuals in the high risk group (78% in women and 56% in men) (Figure 24).

Table 11. Differences in physical measures between women and men (Mann-Whitney test). Values are shown in mean values and standard deviation (SD).

	Women			Men					
	n	Mean	SD	n	Mean	SD	p	z	d
Height (cm)	1908	157.00	6.84	533	170.81	7.42	**<0.001**	29.31	-1.93
Weight (kg)	1965	68.22	12.16	573	79.78	11.74	**<0.001**	19.75	-0.96
BMI (kg/m²)	1827	27.64	5.00	520	27.36	3.86	0.70	-0.36	0.06
Waist circumference (cm)	147	95.62	11.90	64	104.75	10.86	**<0.001**	-4.72	-0.80
Waist-hip ratio	136	0.88	0.06	64	0.99	0.06	**<0.001**	9.79	-1.83
Flexibility (cm)	1265	12.20	9.28	287	8.50	9.35	**<0.001**	-5.81	0.39
Resting systolic BP (mmHg)	430	146.19	14.70	171	146.98	14.60	0.53	0.61	-0.05
Resting diastolic BP (mmHg)	430	84.27	7.69	171	85.16	7.47	0.16	1.4	-0.11
After-exercise systolic BP (mmHg)	395	144.41	16.34	168	146.24	16.05	0.33	0.96	-0.11
After-exercise diastolic BP (mmHg)	395	83.12	9.39	168	83.99	7.17	0.15	1.42	-0.1
Resting HR (bpm)	226	77.63	11.77	89	71.97	14.74	**<0.001**	-3.64	0.42
After- exercise HR (bpm)	226	99.14	16.94	90	92.84	18.55	**0.01**	-2.83	0.35
Total distance in 6MW (m)	220	465.20	61.03	89	491.91	71.75	**<0.001**	3.45	-0.4

n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute,p: significance value, z: z-score, d: effect size (Cohen´s d)

Figure 24. Waist circumference categories in total sample, women and men. Values are shown in percentages (%).



4.3.2.2. Baseline physical measures by age

Tests conducted to evaluate the differences in physical measures among different age groups in women and men showed significant ($p<0.05$) differences in height, weight, BMI , resting and after-exercise systolic blood pressure, resting and after-exercise heart rate and total distance in the 6MW in women and in height, BMI, flexibility and after-exercise heart rate in men (Table 12).

Table 12. Differences in physical measures among age groups in women and men (Kruskal-Wallis Test).

	Women			Men		
	n	H(x)	p	n	H(x)	p
Height (cm)	1908	275.42(6)	**<0.001**	533	118.18(6)	**<0.001**
Weight (kg)	1965	42.52(6)	**<0.001**	573	7.16(6)	0.30
BMI (kg/m²)	1827	177.11(6)	**<0.001**	520	54.72(6)	**<0.001**
Waist circumference (cm)	147	7.64(5)	0.18	64	9.62(5)	0.08
Waist-hip ratio	136	1.75(5)	0.88	64	3.03(5)	0.69
Flexibility (cm)	1265	8.38(6)	0.21	287	15.74(5)	**0.01**
Resting systolic BP (mmHg)	430	13.62(6)	**0.03**	171	2.11(5)	0.83
Resting diastolic BP (mmHg)	430	7.26(6)	0.29	171	5.84(5)	0.32
After-exercise systolic BP (mmHg)	395	13.41(6)	**0.02**	168	5.65(5)	0.34
After-exercise diastolic BP (mmHg)	395	9.45(5)	0.09	168	1.17(5)	0.95
Resting HR (bpm)	226	12.98(6)	**0.04**	89	5.10(5)	0.4
After-exercise HR (bpm)	226	25.50(6)	**<0.001**	90	14.13(5)	**0.02**
Total distance in 6MW (m)	220	26.14(6)	**<0.001**	89	6.43(5)	0.26

n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute,p: significance value, H(x):Kruskal-Wallis test (degrees of freedom)

Significant differences were also found in BMI categories between different age groups ($X^2(18)=264.22$, $p<0.001$) where the 61-70 age group had more overweight and obese participants than the rest of the groups (Figure 25). There were no significant differences among age groups in waist circumference categories but as can be seen in Figure 26, all age groups had a high percentage (84-91%) of individuals with increased and substantially increased waist circumference that could lead to metabolic complications.

Figure 25. BMI categories in total sample and different age groups. Values are shown in percentages (%).

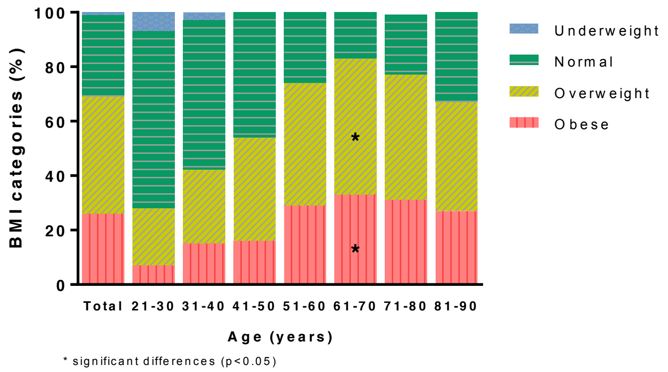


Figure 26. Waist circumference categories in total sample and different age groups. Values are shown in percentages (%).

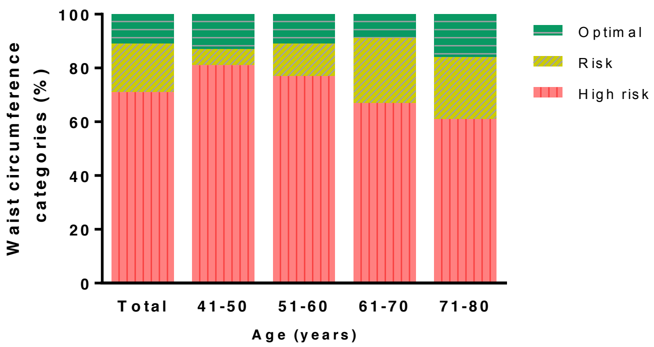


Table 13. Differences in physical measures between age groups in women and men. Pairwise comparisons. Values are shown in mean values and standard deviation (SD).

		Women				Men			
	Age group	n	Mean	SD	sig	n	Mean	SD	sig
Height (cm)	21-30$_1$	29	162.53	6.40		14	178.43	8.53	*4,5,6
	31-40$_2$	145	162.66	6.54		46	177.91	5.93	*4,5,6
	41-50$_3$	373	159.98	6.77	*6	98	174.28	7.31	*4,5,6
	51-60$_4$	654	156.47	6.12	*6	156	169.98	6.64	
	61-70$_5$	486	154.95	6.07		164	168.29	6.23	
	71-80$_6$	209	153.57	6.38		52	166.54	6.13	
	81-90$_7$	12	153.92	5.62		3	167.67	5.51	
Weight (kg)	21-30$_1$	31	63.75	11.93		14	74.93	10.77	
	31-40$_2$	155	65.58	12.24	*4,5	49	82.07	10.69	
	41-50$_3$	396	66.87	12.45	*4,5	112	80.04	13.82	
	51-60$_4$	664	69.76	13.00		167	80.33	11.06	
	61-70$_5$	489	69.21	11.16		170	79.29	11.61	
	71-80$_6$	218	66.47	10.25		57	78.20	10.14	
	81-90$_7$	12	63.91	7.36		4	82.20	17.82	
BMI (kg/m^2)	21-30$_1$	29	24.05	5.26	*4,5,6	14	23.54	2.93	*4,5,6
	31-40$_2$	142	24.71	4.65	*4,5,6	44	25.84	3.12	*4,5,6
	41-50$_3$	363	26.00	4.89	*4,5,6	97	26.27	4.77	*4,5,6
	51-60$_4$	620	28.46	5.26		153	27.73	3.52	
	61-70$_5$	458	28.81	4.42		158	28.10	3.53	
	71-80$_6$	203	28.05	4.04		51	28.23	3.05	
	81-90$_7$	12	27.00	2.99		3	30.27	7.87	
Waist circumference (cm)	21-30$_1$	2	97.50	13.43		0			
	31-40$_2$	2	104.00	0.00		1	116.00		
	41-50$_3$	14	94.50	11.87		2	124.00	0.00	
	51-60$_4$	44	98.02	12.36		21	104.48	10.75	
	61-70$_5$	54	96.24	11.37		26	103.11	10.56	
	71-80$_6$	31	91	11.74		13	103.00	8.68	
	81-90$_7$	0				1	126.00		
Waist-hip ratio	21-30$_1$	2	0.89	0.00		0			
	31-40$_2$	2	0.85	0.06		1	1.07		
	41-50$_3$	13	0.88	0.06		2	1.00	0.03	
	51-60$_4$	40	0.88	0.06		21	0.99	0.08	
	61-70$_5$	51	0.89	0.06		26	1.00	0.05	
	71-80$_6$	28	0.88	0.05		13	0.99	0.06	
	81-90$_7$	0				1	0.97		
Flexibility (cm)	21-30$_1$	20	11.73	6.37		8	14.13	8.46	*6(MW)
	31-40$_2$	105	13.49	8.15		32	10.73	7.89	*6(MW)
	41-50$_3$	280	12.52	9.86		66	10.54	9.23	*5,6(MW)
	51-60$_4$	433	12.70	9.17		87	8.57	8.36	*6(MW)
	61-70$_5$	307	11.50	9.46		70	6.40	10.49	
	71-80$_6$	114	10.51	8.80		24	3.94	9.13	
	81-90$_7$	6	7.25	11.77		0			
Resting systolic BP (mmHg)	21-30$_1$	2	125.00	21.21		1	150.00		
	31-40$_2$	1	150.00			0			
	41-50$_3$	25	144.60	20.16	*6(MW)	8	149.88	13.84	
	51-60$_4$	139	143.73	15.25	*6(MW)	41	145.44	14.15	
	61-70$_5$	167	147.38	13.98	*6(MW)	82	146.50	15.56	
	71-80$_6$	90	148.47	12.94		36	148.69	12.55	
	81-90$_7$	6	148.67	9.63		3	151.67	26.50	

		Women				Men			
	Age group	n	Mean	SD	sig	n	Mean	SD	sig
Resting diastolic BP	21-30$_1$	2	72.50	10.61		1	90.00	-	
(mmHg)	31-40$_2$	1	90.00	-		0	-	-	
	41-50$_3$	25	86.80	8.93		8	87.25	9.48	
	51-60$_4$	139	84.81	7.80		41	86.12	6.52	
	61-70$_5$	167	83.90	7.46		82	85.30	8.05	
	71-80$_6$	90	83.50	7.46		36	83.25	6.90	
	81-90$_7$	6	86.00	5.48		3	83.67	2.31	
After-exercise systolic BP	21-30$_1$	2	110.00	14.14		1	140.00	-	
(mmHg)	31-40$_2$	0	-	-		0	-	-	
	41-50$_3$	22	144.32	25.38		7	143.86	16.90	
	51-60$_4$	125	142.22	16.29	*6(MW)	39	143.15	12.76	
	61-70$_5$	152	145.02	15.16	*6(MW)	83	145.67	17.24	
	71-80$_6$	88	147.17	15.07		35	151.00	15.22	
	81-90$_7$	6	146.00	7.87		3	154.33	26.16	
After-exercise diastolic BP	21-30$_1$	2	70.00	14.14		1	85.00	-	
(mmHg)	31-40$_2$	0	-	-		0	-	-	
	41-50$_3$	22	85.50	10.82		7	83.29	9.86	
	51-60$_4$	125	84.81	12.03		39	83.95	6.40	
	61-70$_5$	152	82.41	7.41		83	84.14	7.80	
	71-80$_6$	88	81.67	7.12		35	83.94	6.45	
	81-90$_7$	6	83.00	8.25		3	82.33	3.21	
Resting HR	21-30$_1$	4	85.00	8.83		0	-	-	
(bpm)	31-40$_2$	7	86.43	15.61		1	89.00	-	
	41-50$_3$	23	84.17	12.21	*4,5,6(MW)	3	75.00	11.53	
	51-60$_4$	69	77.06	11.56		26	71.58	14.20	
	61-70$_5$	73	77.05	11.50		37	72.49	16.54	
	71-80$_6$	49	74.33	10.46		21	68.95	11.49	
	81-90$_7$	1	80.00	-		1	100.00	-	
After-exercise HR	21-30$_1$	4	114.25	16.92		0			
(bpm)	31-40$_2$	7	114.71	21.57		1	132.00		
	41-50$_3$	23	111.00	16.59	*4,5,6	3	102.33	9.81	
	51-60$_4$	69	97.74	15.74		27	96.33	17.56	
	61-70$_5$	73	97.21	15.48		37	93.14	17.12	*6(MW)
	71-80$_6$	49	94.55	16.47		21	82.86	17.71	
	81-90$_7$	1	120.00			1	130.00		
Total distance in 6MW	21-30$_1$	4	517.00	46.02		0			
(m)	31-40$_2$	7	491.71	108.62		1	582.00		
	41-50$_3$	23	499.13	52.20	*6	3	511.67	27.54	
	51-60$_4$	66	475.53	52.01	*6	27	505.89	83.83	
	61-70$_5$	70	458.53	58.34		36	495.44	60.79	
	71-80$_6$	49	437.80	60.70		21	462.48	72.43	
	81-90$_7$	1	420.00			1	456.00		

n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, sig*: significant differences ($p \leq 0.05$), (MW): Mann-Whitney Test. Subscripts below age decades show the groups used for comparisons in the Mann-Whitney Test

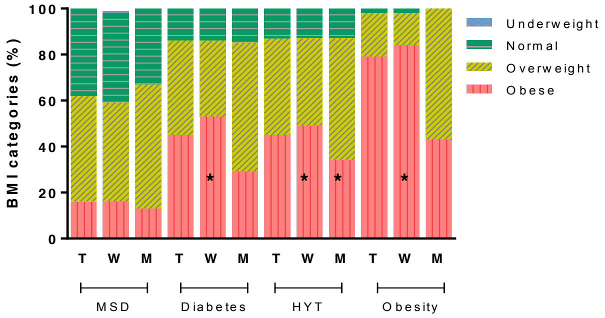
Follow-up tests (Table 13) showed that in height, in both women and men, a significant decreasing trend could be observed as age increased. Only among women, a significant ($p<0.001$) increase in weight occurred until the 61-70 age group where it started to drop. In both women and men, BMI was significantly ($p<0.001$) higher in the older age groups (51-60, 61-70 and 71-80) if compared to the younger groups (21-30, 31-40 and 41-50). Only among men, flexibility significantly ($p=0.01$) decreased as age increased. A similar trend was observed among women but was not statistically significant. Resting and after-exercise systolic blood pressure in women was the highest in the 71-80 age group if compared to the younger groups. Resting heart rate in women showed a significant ($p=0.04$) decreasing trend as age increased. In men the same trend was observed but it was statistically no significant. Similarly, after-exercise heart rate in women and men was significantly ($p<0.001$) lower in the older groups if compared to the younger groups. Total distance in the 6MW in women was significantly ($p<0.001$) lower in the 71-80 group if compared to the younger groups (41-50, 51-60). In both women and men, a decreasing trend of total distance could be observed as age increased even though it was not statistically significant among men (Table 13).

4.3.2.3. Baseline physical measures by diagnosis

When analyzing baseline physical measures among diagnosis groups in women and men, significant differences ($p<0.05$) in height, weight, BMI and flexibility were found in both men and women. Only among different diagnose groups in women, significant differences ($p<0.05$) were also found in waist circumference, resting and after-exercise systolic blood pressure, in resting and after-exercise heart rate and in total distance (Table 14).

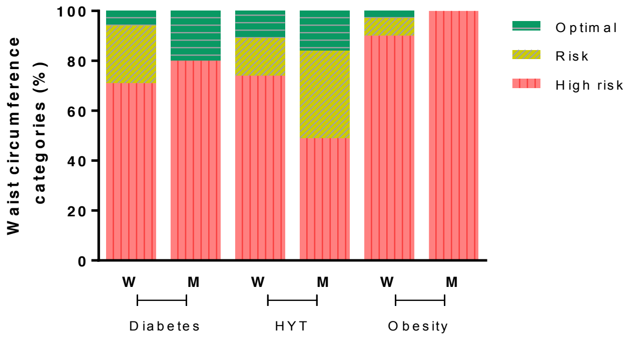
BMI categories also showed significant differences in women ($X^2(9)$ =372.9, $p<0.001$) and men ($X^2(9)$ =47.72(9), $p<0.001$) among diagnosis groups (Figure 27). Women on the diabetes, hypertension and obesity group and men on the hypertension group had more obese individuals than the other groups. No significant differences among diagnose groups were found in waist circumference categories but as can be seen in Figure 28, a high percentage of individuals in every group (80-100%) had an increased or substantially increased waist circumference.

Figure 27. BMI categories in different diagnose groups in total sample, women and men. Values are shown in percentages (%).



*significant differences ($p<0.05$), T: total, W: women, M: men, MSD: musculoskeletal disorders, HYT: hypertension

Figure 28. Waist circumference categories in different diagnose groups in total sample, women and men. Values are shown in percentages (%).



Not on the graph: only two individuals with waist-circumference measures in MSD group and both with a high-risk waist-circumference.

Table 14. Differences in physical measures among different diagnose groups in women and men (Kruskal-Wallis test and pairwise comparisons). Values are shown in mean values and standard deviation (SD).

		Women							Men						
		MSD$_1$	D$_2$	HYT$_3$	O$_4$	p	Pairwise	H(x)	MSD$_1$	D$_2$	HYT$_3$	O$_4$	p	Pairwise	H(x)
Height	n	1372	77	354	105		1-2*, 1-3*		340	38	141	14			
(cm)	Mean	157.54	154.18	155.46	157.18	**<0.001**	2-4*	1908(3)	172.33	165.97	168.50	170.29	**<0.001**	1-2*, 1-3*	49.22(3)
	SD	7.04	5.96	5.93	6.35				7.42	6.62	6.56	6.69			
Weight	n	1411	81	365	108		1-2*,1-3*		373	41	144	15		1-3*, 1-4*	
(kg)	Mean	65.21	73.26	73.81	84.78	**<0.001**	1-4*, 2-4*	315(3)	78.34	80.38	82.36	89.34	**<0.001**	2-4*, 3-4*	22.67(3)
	SD	10.17	12.56	12.37	13.76		3-4*		10.59	13.51	13.35	9.52			
BMI	n	1313	73	338	103		1-2*,1-3*		334	35	137	14		1-2*, 1-3*	
	Mean	26.22	31.02	30.45	34.20	**<0.001**	1-4*, 2-4*	378.2(3)	26.41	28.83	28.96	30.78	**<0.001**	1-4*	61.96(3)
	SD	4.10	5.11	4.96	5.26		3-4*		3.43	4.77	3.80	3.64			
Waist circumference (cm)	n	5	17	95	30				2	10	49	3			
	Mean	104.60	98.70	93.34	99.63	**0.004**	3-4*	13.29(3)	103.50	108.70	103.38	114.66	0.18	.	4.81(3)
	SD	7.98	14.13	11.83	9.32				12.02	12.14	10.33	12.05			
Waist-hip ratio	n	5	15	87	29				2	10	49	3			
	Mean	0.87	0.92	0.88	0.88	0.06	.	7.25(3)	1.03	1.01	0.99	1.01	0.71	.	1.35(3)
	SD	0.07	0.06	0.06	0.05				0.05	0.06	0.07	0.06			
Flexibility	n	1070	18	127	50				239	4	40	4		1-3* (MW)	
(cm)	Mean	12.52	12.22	9.56	11.87	**0.002**	1-3*	14.8(3)	9.00	14.25	4.18	16.38	**0.006**	3-4*(MW)	12.47(3)
	SD	9.33	6.73	9.20	8.30				9.03	4.99	10.46	3.77			
Resting systolic BP	n	48	37	332	13		1-3* (MW)		18	15	135	3			
(mmHg)	Mean	141.40	141.95	147.48	142.85	**0.03**	2-3* (MW)	8.76(3)	147.94	148.27	146.73	145.67	0.83	.	0.84(3)
	SD	14.40	13.35	14.80	11.33				14.48	17.91	13.94	32.35			
Resting diastolic BP	n	48	37	332	13				18	15	135	3			
(mmHg)	Mean	83.77	81.65	84.75	81.23	0.08	.	6.68(3)	85.89	85.20	85.21	78.33	0.43	.	2.75(3)
	SD	8.43	7.15	7.58	7.74				3.85	8.32	7.73	7.64			

		Women							Men						
		MSD_1	D_2	HYT_3	O_4	p	Pairwise	H(x)	MSD_1	D_2	HYT_3	O_4	p	Pairwise	H(x)
After-exercise systolic BP	n	42	34	308	11		1-3* (MW)		18	17	130	3			
(mmHg)	Mean	138.83	140.09	145.79	140.45	**0.04**	2-3* (MW)	8.2(3)	148.94	148.12	145.39	156.33	0.43	.	2.77(3)
	SD	14.98	14.49	16.66	10.54				14.10	19.04	15.80	22.50			
After-exercise diastolic BP	n	42	34	308	11				18	17	130	3			
(mmHg)	Mean	81.86	82.38	83.44	81.18	0.08	.	6.64(3)	85.89	84.47	83.78	79.00	0.53	.	2.19(3)
	SD	9.11	19.88	7.52	8.78				7.52	4.68	7.38	7.21			
Resting HR	n	30	22	133	41				5	9	71	4			
(bpm)	Mean	80.77	85.41	75.52	78.02	**0.003**	2-3*	14.14(3)	66.00	73.22	71.80	79.50	0.58	.	1.96(3)
	SD	9.41	14.23	10.77	13.06				13.21	16.76	14.51	18.27			
After-exercise HR	n	30	22	133	41				5	10	71	4	0.19		
(bpm)	Mean	98.53	107.05	96.32	104.49	**0.002**	2-3*	14.33(3)	82.20	102.80	91.23	110.00		.	5.65(3)
	SD	19.31	18.40	15.36	17.22				19.27	22.79	16.81	24.28			
Total distance in 6MW	n	28	22	132	38				5	10	70	4			
(m)	Mean	482.43	453.00	458.14	484.11	**0.04**	3-4*(MW)	8.06(3)	527.60	502.50	485.84	527.00	0.42	.	2.77(3)
	SD	63.86	72.23	56.57	62.62				68.85	53.87	74.57	55.53			

MSD: musculoskeletal disorders, D: diabetes, HYT: Hypertension, O: Obesity, n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, p: significance value, *significant differences H(x)= Kruskal-Walllis test (degrees of freedom), (MW): Mann-Whitney Test

In women, pairwise comparisons (Table 14) showed that weight and BMI were significantly ($p<0.001$) different among all the diagnose groups except between the diabetes (73.26±12.56 kg and 31.02±5.11 kg/m^2) and the hypertension group (73.81±12.37 kg and 30.45±4.96 kg/m^2). The MSD group had the lowest weight and BMI (65.21±10.17 kg and 26.22±4.10 kg/m^2) and the obesity group had the highest (84.78±13.76 kg and 34.20±5.26 kg/m^2, respectively). Obese women also had significantly ($p=0.004$) greater waist circumference (99.63±9.32 cm) than the women in the hypertension group (93.34±11.83 cm). Even though there were no significant differences in WHR among diagnose groups ($p=0.06$), it could be observed that the diabetes group had a higher index (0.92) than the rest of the groups (0.88). The MSD group was found to be significantly more flexible than the hypertension group (12.52±9.33 vs. 9.56±9.19 cm, $p=0.002$).

Regarding blood pressure, the MSD and the diabetes group had significantly lower resting systolic blood pressure than the hypertension group (141.4±14.4 and 141.95±13.35 mmHg vs. 147.48±14.80 mmHg, $p=0.03$) and also lower after-exercise systolic blood pressure (138.83±14.98 and 140.09±14.49 mmHg vs. 145.79±16.66 mmHg, $p=0.04$).The diabetes group had significantly higher resting and after-exercise heart rate than the hypertension group (85.41±14.22 vs.75.52±10.77 bpm and 107.05±18.40 vs. 96.32±15.36 bpm, respectively, $p=0.003$). Total distance in the obesity group was also found to be significantly higher than in the hypertension group (484.11±62.62 vs. 458.14±56.57 m, $p=0.04$).

Among men, the MSD group had significantly ($p<0.001$) lower weight (78.34±10.59 kg) than the hypertension (82.36±13.35 kg) and the obesity group (89.34±9.52 kg). The obesity group had significantly ($p<0.001$) higher weight than the rest of the groups. The MSD group also had significantly ($p<0.001$) lower BMI (26.41±3.43 kg/m^2) than the rest of the groups. The hypertension group had significantly ($p=0.006$) lower flexibility than the MSD and the obesity group (4.18±10.46 vs. 9±9.03 and 16.38±3.77 cm).

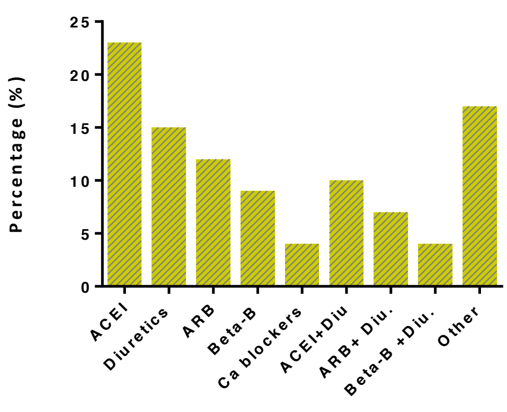
4.3.2.3.1. Hypertension group characteristics

In the hypertension group 65.2% of the participants were under hypertensive medication. The most used medication types were angiotensin-converting enzyme inhibitors (ACEI) (23%) and diuretics (15%) (Figure 29).

There were no significant differences between the medication group and the non-medication group in baseline physical measures except in resting and after-exercise diastolic blood pressure. Patients under medication had significantly (p<0.001) lower diastolic blood pressure than those taking no medication (Table 15).

Significant differences (p=0.01) were also found among different medication groups in after exercise diastolic blood pressure and resting and after exercise heart rate (Table 16). Follow-up tests showed that the ACEI group had significantly (p=0.01) higher after exercise diastolic blood pressure than the Beta-blockers and the Calcium-blocker groups. Patients using beta-blockers had the lowest after exercise diastolic blood pressure (79.96±5.82 mmHg). Similar results were found in resting heart rate where Beta-blockers users had the lowest resting heart rate and the ACEI users the highest. Regarding after exercise HR, both Beta-blocker users and Calcium-blocker users had lower measures than the rest of the groups.

Figure 29. Medication type use in the medicated patients in the hypertension group. Values are shown in percentages (%).



ACEI: angiotensin-converting enzyme inhibitor, ARB: angiotensin receptor blocker, Beta-B: beta blockers, Ca: Calcium, Diu: diuretics

Table 15. Differences in blood pressure between medicated and non-medicated patients in the hypertension group (Mann-Whitney Test).

	Medicated			Non-medicated			
	n	Mean	SD	n	Mean	SD	p
Resting systolic BP (mmHg)	314	146.82	13.639	153	148.19	16.261	0.55
Resting diastolic BP (mmHg)	314	84.11	7.679	153	86.48	7.251	**<0.001**
After-exercise systolic BP (mmHg)	313	144.87	14.956	125	147.68	19.456	0.22
After-exercise diastolic BP (mmHg)	313	82.86	7.110	125	85.27	8.087	**<0.001**

n: number of individuals, SD: standard deviation, BP: blood pressure, mmHg: millimeter of mercury, p: significance value

Table 16. Differences in physical measures among medication type groups (Kruskal-Wallis Test) and paiwise comparison between groups (Mann-Whitney Test).

	ACEI$_1$		Diuretics$_2$		ARB$_3$		Beta-B$_4$		Ca blockers$_5$			
	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD	n	Mean±SD	p	Paiwise (MW)
AE diast. BP	70	84.96±7.66	44	81.77±5.73	38	82.18±6.51	26	79.96±5.82	14	81.57±5.72	**0.01**	1-2*, 1-4*
Rest.HR	40	79.25±12.46	21	76.71±8.61	25	74.56±9.88	10	63.20±13.54	5	66.20±8.04	**0.01**	1-4*, 1-5*, 2-4*, 2-5*,3-4*
AE HR	40	97.95±13.97	21	97.71±13.26	25	97.95±13.97	10	83.10±12.76	5	78.40±14-18	**0.01**	1-4*, 1-5*, 2-4*, 2-5*, 3-4*

n: number of individuals, SD: standard deviation, ACEI:angiotensin-converting enzyme inhibitor, ARB: angiotensin receptor blocker, Beta-B: beta blocker, Ca: calcium, AE: after-exercise, Rest: resting, diast: diastolic, BP: blood pressure, HR: heart rate, ,p: significance value, (MW): Mann-Whitney Test

4.4. Changes in physical measures

4.4.1. Changes in physical measures in the total sample

All physical measures showed significant (p<0.05) changes along the program except resting and after-exercise heart rate (Table 17).

Table 17. Changes in physical measures along the program in the total sample (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	583	71.30±13.11	70.79±12.96	70.76±12.89	70.69±13.08	47.27	**<0.001**
BMI (kg/m^2)	562	28.27±4.86	28.08±4.79	28.06±4.79	28.03±4.87	46.49	**<0.001**
Waist circumference (cm)	57	99.61±12.28	98.98±12.33	98.98±12.06	98.54±11.99	11.62	**0.01**
Waist-hip ratio	54	0.92±0.07	0.91±0.07	0.91±0.07	0.91±0.07	9.40	**0.02**
Flexibility (cm)	200	13.64±9.43	15.92±9.70	16.66±7.88	17.36±7.98	131.87	**<0.001**
Resting systolic BP (mmHg)	115	147.66±14.01	144.76±12.74	144.88±13.57	142.35±14.51	10.06	**0.02**
Resting diastolic BP (mmHg)	115	85.46±6.34	83.25±6.71	82.97±7.13	81.87±8.57	23.64	**<0.001**
After-exercise systolic BP (mmHg)	103	146.58±16.82	144.17±14.21	142.95±13.13	141.03±12.75	8.28	**0.04**
After-exercise diastolic BP (mmHg)	103	84.06±7.26	81.75±6.64	81.50±6.55	80.61±7.18	17.49	**<0.001**
Resting HR (bpm)	87	75.01±12.53	75.44±13.13	76.05±12.68	74.22±15.21	5.85	0.11
After-exercise HR (bpm)	87	98.55±17.83	96.05±16.01	98.10±17.36	97.01±16.56	1.60	0.65
Total distance in 6MW (m)	86	479.32±59.63	494.19±53.02	495.50±57.31	502.22±61.27	28.43	**<0.001**

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

To follow-up these findings measurements at baseline were compared with measurements at three, six and nine months (Table 18). Results showed significant (p<0.05) changes in all physical measures between baseline and the three month measurement except in WHR and resting heart rate. Changes between baseline and six months were also significant (p<0.05) in all the physical measures except in waist circumference and resting and after-exercise heart rate. Similarly, changes after nine months showed significant (p<0.05) changes in all physical measures except in waist circumference and resting and after-exercise heart rate.

At nine months, results showed very small effect sizes in weight (d=0.03), BMI (d=0.03) and WHR (d=0.14). Effect sizes for these variables at three months and at six months were also very small (Table 18).

Flexibility significantly (p<0.001) improved after nine months, from 13.04±10.00 to 16.62±8.50 cm, with a small- medium effect size (d=-0.38). Significant (p<0.001) changes also occurred at three months and at six months, however, effect sizes were lower in the first measurement (d=0.23) if compared to the six and the nine month measurements (d=-0.36 and d=-0.38 respectively).

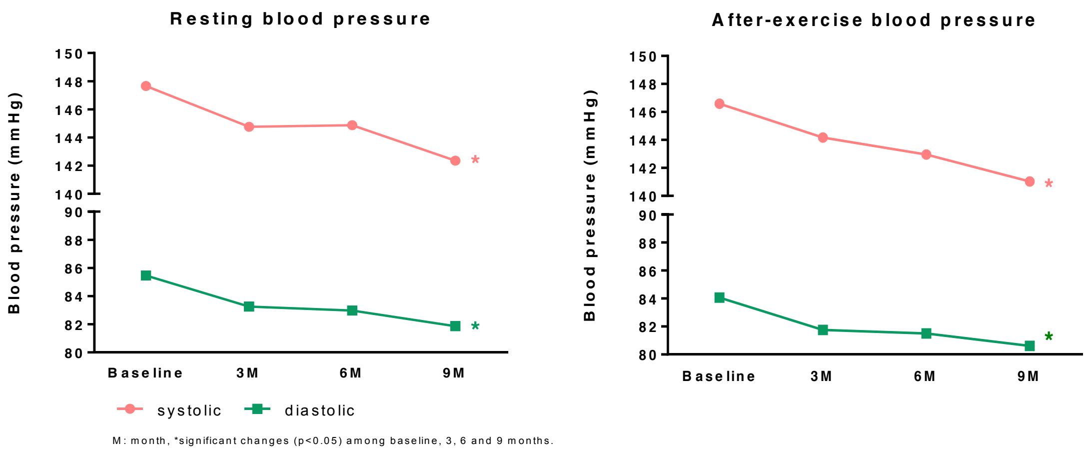
Table 18. Changes in physical measures between baseline and 3, 6 and 9 months (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Weight (kg)	1796	70.71±12.75	70.32±12.69	**<0.001**	0.03
BMI (kg/m²)	1718	27.67±4.67	27.52±4.63	**<0.001**	0.03
Waist circumference (cm)	159	97.97±12.22	97.65±12.17	**0.02**	0.03
Waist-hip ratio	152	0.91±0.07	0.91±0.08	0.13	0.00
Flexibility (cm)	999	11.45±9.59	13.73±9.75	**<0.001**	-0.23
Resting systolic BP (mmHg)	418	146.88±15.16	143.56±15.91	**<0.001**	0.21
Resting diastolic BP (mmHg)	416	84.74±7.53	82.87±7.85	**<0.001**	0.24
After-exercise systolic BP (mmHg)	385	145.19±16.69	143.09±15.54	**<0.001**	0.13
After-exercise diastolic BP (mmHg)	385	83.36±7.55	81.4±7.60	**<0.001**	0.26
Resting HR (bpm)	250	75.92±12.74	75.76±12.77	0.73	0.01
After-exercise HR (bpm)	250	97.36±16.80	95.12±15.82	**0.005**	0.14
Total distance in 6MW (m)	242	476.31±62.04	492.59±57.53	**<0.001**	-0.27
	n	Baseline	6 month	p	d
Weight (kg)	1456	71.01±12.73	70.61±12.63	**<0.001**	0.03
BMI (kg/m²)	1378	27.97±4.65	27.80±4.59	**<0.001**	0.03
Waist circumference (cm)	95	99.38±11.47	99.10±11.85	0.25	0.02
Waist-hip ratio	87	0.92±0.07	0.91±0.07	**0.04**	0.14
Flexibility (cm)	671	11.49±9.56	14.78±8.64	**<0.001**	-0.36
Resting systolic BP (mmHg)	286	146.40±14.47	142.53±13.31	**<0.001**	0.28
Resting diastolic BP (mmHg)	286	85.40±6.91	82.52±7.54	**<0.001**	0.40
After-exercise systolic BP (mmHg)	263	145.33±16.77	140.82±12.95	**<0.001**	0.30
After-exercise diastolic BP (mmHg)	263	83.92±7.45	81.29±7.18	**<0.001**	0.36
Resting HR (bpm)	146	76.58±13.66	76.48±13.40	0.96	0.01
After-exercise HR (bpm)	146	98.59±17.25	97.67±17.30	0.27	0.05
Total distance in 6MW (m)	143	473.96±63.08	490.75±61.97	**<0.001**	-0.27
	n	Baseline	9 month	p	d
Weight (kg)	915	70.87±13.00	70.42±12.91	**<0.001**	0.03
BMI (kg/m²)	867	28.02±4.84	27.84±4.79	**<0.001**	0.03
Waist circumference (cm)	83	99.16±11.85	98.43±11.39	0.17	0.06
Waist-hip ratio	76	0.92±0.07	0.91±0.07	**0.02**	0.00
Flexibility (cm)	353	13.04±10.00	16.62±8.50	**<0.001**	-0.38
Resting systolic BP (mmHg)	202	148.08±13.53	143.18±14.15	**<0.001**	0.35
Resting diastolic BP (mmHg)	202	85.21±6.78	82.45±6.60	**<0.001**	0.41
After-exercise systolic BP (mmHg)	184	146.37±15.34	141.53±12.89	**<0.001**	0.34
After-exercise diastolic BP (mmHg)	184	84.14±10.48	80.74±7.65	**<0.001**	0.37
Resting HR (bpm)	118	75.80±12.35	75.05±13.97	0.44	0.05
After-exercise HR (bpm)	118	98.93±17.11	97.29±15.25	0.38	0.10
Total distance in 6MW (m)	114	474.09±60.41	497.28±58.40	**<0.001**	-0.39

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, p: significance value, d: effect size (Cohen´s d)

Similarly, resting systolic and diastolic blood pressure and after-exercise systolic and diastolic blood pressure significantly (p <0.001) decreased at all follow-ups but the largest effect sizes occurred at the nine months follow-up where resting systolic blood pressure decreased from 148.08±13.53 to 143.18±14.15 mmHg (d=0.35), resting diastolic BP decreased from 85.21±6.78 to 82.45±6.60 mmHg (d=0.41), after-exercise systolic decreased from 146.37±15.34 to 141.53±12.89 mmHg (d=0.34) and after-exercise diastolic decreased from 84.14±10.48 to 80.74±7.65 mmHg (d=0.37)(see Figure 30).

Figure 30. Mean changes in blood pressure measures along the program in the total sample (Friedman´s ANOVA). Standard deviations are shown in Table 17.



Results in total distance in the 6MW also showed the greatest improvements (d=-0.39) in the last follow-up (from 474.09±60.41 to 497.28±58.40 m) even though changes were already occurring at the first and second measurement points (d=-0.27).

4.4.2. Changes in physical measures by groups

4.4.2.1. Changes in physical measures by gender

Changes in physical measures along the program in women and men can be observed in Table 19 and Figures 31-34. In women, all physical measures significantly (p<0.05) changed over the nine months except resting and after-exercise heart rate. In men, weight, BMI, flexibility, resting diastolic blood pressure and after-exercise systolic and diastolic blood pressure showed significant (p<0.05) changes along the program.

Followed-up tests can be seen in Tables 20-21. In women, results showed significant ($p<0.003$) changes at three months in all physical measures except in waist circumference, WHR and resting heart rate. However, only flexibility ($d=-0.24$), resting diastolic blood pressure ($d=0.23$), after-exercise diastolic blood pressure ($d=0.29$) and total distance in the 6MW ($d=-0.24$) showed effect sizes greater than 0.20. At six months, all physical measures showed significant ($p\leq0.03$) changes except waist circumference and resting and after-exercise heart rate. Flexibility and resting and after-exercise diastolic blood pressure increased their effect sizes if compared to the previous follow-up (Table 20). Moreover, WHR ($d=0.20$), resting systolic blood pressure ($d=0.32$) and after exercise systolic blood pressure ($d=0.32$) reached effect sizes greater than 0.20. At nine months, effect sizes continued increasing except in resting and after-exercise diastolic blood pressure. WHR decreased from 0.89±0.05 to 0.88±0.04 ($d=0.22$), flexibility improved from 13.97±9.75 to 17.56±7.87 cm ($d=-0.40$), resting systolic blood pressure decreased from 148.33±13.75 to 142.80±14.35 mmHg ($d=0.39$), resting diastolic blood pressure decreased from 85.06±7.04 to 82.42±8.73 mmHg ($d=0.33$), after-exercise systolic blood pressure decreased from 146.19±16.33 to 140.72±12.31 mmHg ($d=0.39$), after exercise diastolic blood pressure decreased from 84.05±12.05 to 80.67±7.47 mmHg ($d=0.33$) and total distance increased from 467.93±60.82 to 491.64±55.35 m ($d=-0.41$).

In men, after three months, weight, BMI, flexibility, resting systolic and diastolic blood pressure, after-exercise systolic and diastolic blood pressure and total distance significantly ($p\leq0.01$) changed but effect sizes in weight and in BMI were small ($d=0.03$)(Table 15). At six months, the previous same variables maintained their significant changes except resting systolic blood pressure and after exercise diastolic blood pressure. The effect sizes in these variables increased from the first measurement except in total distance where the effect size decreased ($d=-0.31$). At nine months, only flexibility, resting and after-exercise diastolic blood pressure and total distance showed significant ($p\leq0.01$) changes although after-exercise systolic blood pressure showed a trend towards significance ($p=0.07$). These variables reached their highest effect sizes if compared to the previous follow-ups. Flexibility improved from 7.87±9.87 to 11.37±9.96 cm ($d=-0.35$), resting systolic blood pressure decreased from 147.5±13.08 to 144.1±13.75 mmHg ($d=0.25$) even though it did not reach statistical significance ($p=0.11$), resting diastolic blood pressure decreased from 85.55±6.19 to 82.51±8.32 mmHg ($d=0.41$), after-exercise systolic blood pressure decreased from 146.75±13.17 to 143.18±13.98 mmHg ($d=0.26$, $p=0.07$), after-exercise diastolic blood pressure decreased from 84.35±6.17 to 80.88±8.07 mmHg ($d=0.48$) and total distance increased from 491.36±60.82 to 513.06±64.58 m ($d=-0.36$) (Table 21).

Table 19. Changes in physical measures along the program in women and men (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	463	68.89±12.55	68.38±12.38	68.40±12.36	68.30±12.52	37.21	**<0.001**
BMI (kg/m²)	445	28.30±5.11	28.10±5.03	28.10±5.03	28.06±5.11	35.88	**<0.001**
Waist circumference (cm)	44	97.20±11.59	96.45±11.56	96.50±11.14	95.86±10.76	12.61	**0.01**
Waist-hip ratio	41	0.89±0.04	0.88±0.04	0.88±0.04	0.88±0.04	8.53	**0.03**
Flexibility (cm)	170	14.18±9.33	16.39±9.58	17.35±7.65	17.95±7.97	114.75	**<0.001**
Resting systolic BP (mmHg)	76	147.84±14.20	146.04±13.29	144.17±13.94	141.24±14.39	9.37	**0.02**
Resting diastolic BP (mmHg)	76	85.00±6.66	83.17±6.62	82.28±7.56	81.57±8.82	14.94	**0.002**
After-exercise systolic BP (mmHg)	66	145.65±17.97	145.45±13.06	141.56±12.88	140.00±11.64	12.26	**0.01**
After-exercise diastolic BP (mmHg)	66	83.21±7.83	81.85±6.59	80.61±6.33	80.45±6.14	10.06	**0.02**
Resting HR (bpm)	61	77.64±11.85	78.23±12.47	78.69±12.63	77.82±15.57	2.22	0.52
After-exercise HR (bpm)	61	102.61±17.26	100.26±15.19	102.92±16.35	100.26±16.37	2.87	0.41
Total distance in 6MW (m)	60	473.45±59.1	486.95±49.8	489.70±50.9	497.28±58.1	21.46	**<0.001**
Men	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	120	80.59±10.92	80.07±10.80	79.87±10.68	79.90±10.93	10.98	**0.01**
BMI (kg/m²)	117	28.18±3.78	27.99±3.73	27.93±3.73	27.94±3.83	11.31	**0.01**
Waist circumference (cm)	13	107.77±11.36	107.54±11.31	107.38±11.62	107.61±11.86	1.72	0.63
Waist-hip ratio	13	1.02±0.04	1.02±0.05	1.02±0.04	1.02±0.04	1.27	0.73
Flexibility (cm)	30	10.60±9.55	13.24±10.13	12.72±8.10	14.00±7.28	17.32	**<0.001**
Resting systolic BP (mmHg)	39	147.31±13.82	142.26±11.33	146.26±12.88	144.51±14.70	3.94	0.27
Resting diastolic BP (mmHg)	39	86.36±5.63	83.41±6.96	84.31±6.07	82.46±8.12	10.75	**0.01**
After- exercise systolic BP (mmHg)	37	148.24±14.63	141.89±15.99	145.43±13.39	142.86±14.49	11.09	**0.01**
After-exercise diastolic BP (mmHg)	37	85.57±5.91	81.57±6.81	83.11±6.71	80.89±8.83	13.41	**0.004**
Resting HR (bpm)	26	68.85±12.12	68.88±12.50	69.85±10.63	65.77±10.37	4.74	0.19
After-exercise HR (bpm)	26	89.04±15.64	86.15±13.52	86.81±14.35	89.38±14.62	0.66	0.88
Total distance in 6MW (m)	26	492.88±59.5	510.92±57.2	508.88±69.1	513.61±67.7	7.24	0.06

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

Table 20. Changes in physical measures between baseline and 3, 6 and 9 months in women (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Weight (kg)	1390	68.12±11.86	67.71±11.74	**<0.001**	0.03
BMI (kg/m²)	1331	27.74±4.92	27.58±4.86	**<0.001**	0.03
Waist circumference (cm)	113	95.28±11.81	94.97±11.64	0.07	0.03
Waist-hip ratio	107	0.88±0.05	0.87±0.06	0.11	0.18
Flexibility (cm)	812	12.13±9.46	14.44±9.50	**<0.001**	-0.24
Resting systolic BP (mmHg)	290	146.58±15.30	143.42±17.02	**<0.001**	0.19
Resting diastolic BP (mmHg)	288	84.35±7.61	82.55±7.95	**<0.001**	0.23
After-exercise systolic BP (mmHg)	262	144.76±16.80	142.49±15.52	**0.003**	0.14
After-exercise diastolic BP (mmHg)	262	82.96±7.59	80.79±7.47	**<0.001**	0.29
Resting HR (bpm)	174	77.86±11.26	77.82±12.08	0.82	0.03
After-exercise HR (bpm)	174	100.35±15.75	97.37±15.20	**0.002**	0.19
Total distance in 6MW (m)	168	469.16±58.02	482.38±53.48	**<0.001**	-0.24
	n	Baseline	6 month	p	d
Weight (kg)	1145	68.69±12.07	68.26±11.91	**<0.001**	0.03
BMI (kg/m²)	1084	28.07±4.89	27.88±4.82	**<0.001**	0.03
Waist circumference (cm)	72	97.33±10.95	96.98±10.50	0.24	0.03
Waist-hip ratio	64	0.89±0.05	0.88±0.05	**0.03**	0.20
Flexibility (cm)	569	11.91±9.66	15.24±8.60	**<0.001**	-0.36
Resting systolic BP (mmHg)	203	146.73±14.82	142.17±13.45	**<0.001**	0.32
Resting diastolic BP (mmHg)	203	85.23±6.93	82.20±7.60	**<0.001**	0.41
After-exercise systolic BP (mmHg)	183	145.35±17.58	140.32±13.19	**<0.001**	0.32
After-exercise diastolic BP (mmHg)	183	83.70±7.68	80.56±6.93	**<0.001**	0.42
Resting HR (bpm)	105	77.95±12.09	78.05±12.60	0.95	-0.01
After-exercise HR (bpm)	105	101.24±16.74	100.69±16.74	0.39	0.03
Total distance in 6MW (m)	102	466.30±60.79	481.47±56.74	**<0.001**	-0.26
	n	Baseline	9 month	p	d
Weight (kg)	727	68.63±12.50	68.18±12.41	**<0.001**	0.03
BMI (kg/m²)	690	28.08±5.06	27.89±5.02	**<0.001**	0.03
Waist circumference (cm)	67	97.85±11.45	96.89±10.71	0.09	0.08
Waist-hip ratio	60	0.89±0.05	0.88±0.04	**0.004**	0.22
Flexibility (cm)	299	13.97±9.75	17.56±7.87	**<0.001**	-0.40
Resting systolic BP (mmHg)	142	148.33±13.75	142.80±14.35	**<0.001**	0.39
Resting diastolic BP (mmHg)	142	85.06±7.04	82.42±8.73	**<0.001**	0.33
After-exercise systolic BP (mmHg)	124	146.19±16.33	140.72±12.31	**<0.001**	0.39
After-exercise diastolic BP (mmHg)	124	84.05±12.05	80.67±7.47	**<0.001**	0.33
Resting HR (bpm)	88	77.56±11.81	77.69±14.04	0.93	-0.01
After-exercise HR (bpm)	88	101.59±16.82	99.81±14.99	0.42	0.11
Total distance in 6MW (m)	84	467.93±60.82	491.64±55.35	**<0.001**	-0.41

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, p: significance value, d: effect size (Cohen´s d)

Table 21. Changes in physical measures between baseline and 3, 6 and 9 months in men (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Weight (kg)	406	79.59±11.66	79.28±11.72	**<0.001**	0.03
BMI (kg/m²)	387	27.43±3.73	27.32±3.73	**<0.001**	0.03
Waist circumference (cm)	46	104.59±10.70	104.22±10.97	0.07	0.03
Waist-hip ratio	45	0.99±0.07	0.99±0.05	0.71	0.00
Flexibility (cm)	187	8.49±9.61	10.63±10.25	**<0.001**	-0.21
Resting systolic BP (mmHg)	128	147.55±14.90	143.88±13.13	**<0.001**	0.26
Resting diastolic BP (mmHg)	128	85.62±7.33	83.60±7.61	**0.006**	0.27
After-exercise systolic BP (mmHg)	123	146.09±16.49	144.36±15.56	0.05	0.11
After-exercise diastolic BP (mmHg)	123	84.21±7.43	82.68±7.74	**0.01**	0.20
Resting HR (bpm)	76	71.47±14.75	71.06±13.15	0.79	0.03
After-exercise HR (bpm)	76	90.51±17.23	89.97±16.11	0.55	0.03
Total distance in 6MW (m)	74	492.55±68.01	515.77±60.01	**<0.001**	-0.36
	n	Baseline	6 month	p	d
Weight (kg)	311	79.55±11.43	79.25±11.42	0.05	0.03
BMI (kg/m²)	294	27.62±3.64	27.5±3.62	**0.04**	0.03
Waist circumference (cm)	23	105.78±10.86	105.74±11.06	0.96	0.00
Waist-hip ratio	23	0.99±0.08	1.01±0.05	0.67	-0.29
Flexibility (cm)	102	9.14±8.70	12.20±8.43	**<0.001**	-0.36
Resting systolic BP (mmHg)	83	145.60±13.60	143.42±13.01	0.12	0.16
Resting diastolic BP (mmHg)	83	85.84±6.89	83.31±7.39	**0.003**	0.35
After-exercise systolic BP (mmHg)	80	145.28±14.87	141.95±12.40	**0.02**	0.24
After-exercise diastolic BP (mmHg)	80	84.42±6.92	82.97±7.51	0.10	0.20
Resting HR (bpm)	41	73.07±16.71	72.46±14.63	0.95	0.04
After-exercise HR (bpm)	41	91.83±16.87	89.93±16.42	0.52	0.11
Total distance in 6MW (m)	41	493.00±65.37	513.83±68.85	**0.02**	-0.31
	n	Baseline	9 month	p	d
Weight (kg)	188	79.51±11.18	79.05±11.09	0.12	0.04
BMI (kg/m²)	177	27.80±3.84	27.62±3.82	0.09	0.04
Waist circumference (cm)	16	104.62±12.32	104.87±12.27	0.44	-0.02
Waist-hip ratio	16	1.01±0.05	1.01±0.04	0.61	0.00
Flexibility (cm)	54	7.87±9.87	11.37±9.96	**<0.001**	-0.35
Resting systolic BP (mmHg)	60	147.5±13.08	144.1±13.75	0.11	0.25
Resting diastolic BP (mmHg)	60	85.55±6.19	82.51±8.32	**0.01**	0.41
After-exercise systolic BP (mmHg)	60	146.75±13.17	143.18±13.98	0.07	0.26
After-exercise diastolic BP (mmHg)	60	84.35±6.17	80.88±8.07	**0.002**	0.48
Resting HR (bpm)	30	70.63±12.65	67.3±10.74	0.18	0.28
After-exercise HR (bpm)	30	91.13±15.77	89.93±13.73	0.72	0.08
Total distance in 6MW (m)	30	491.36±56.68	513.06±64.58	**0.01**	-0.36

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, p: significance value, d: effect size (Cohen´s d)

Figure 31. Mean changes in weight and BMI in total sample, women and men (Friedman´s ANOVA). Standard deviations are shown in Table 17 and 19.

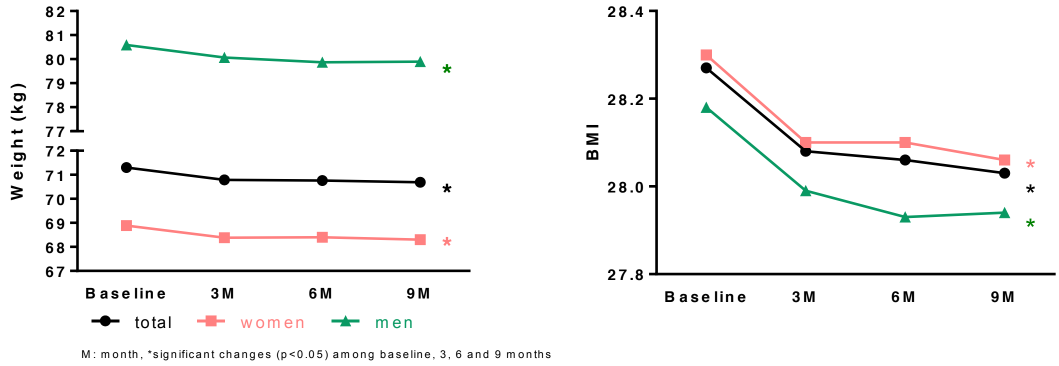


Figure 32. Mean changes in waist circumference and flexibility along the program in total sample, women and men (Friedman´s ANOVA). Standard deviations are shown in Table 17 and 19.

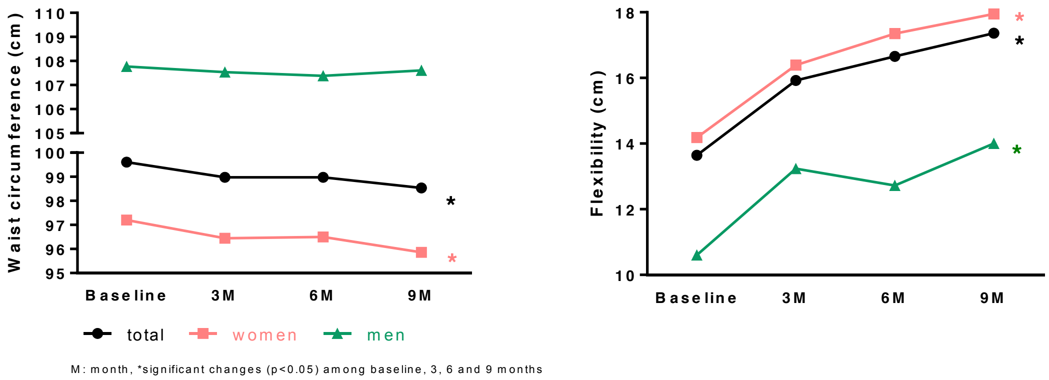


Figure 33. Mean changes in blood pressure measures along the program in total sample, women and men (Friedman´s ANOVA). Standard deviations are shown in Table 17 and 19.

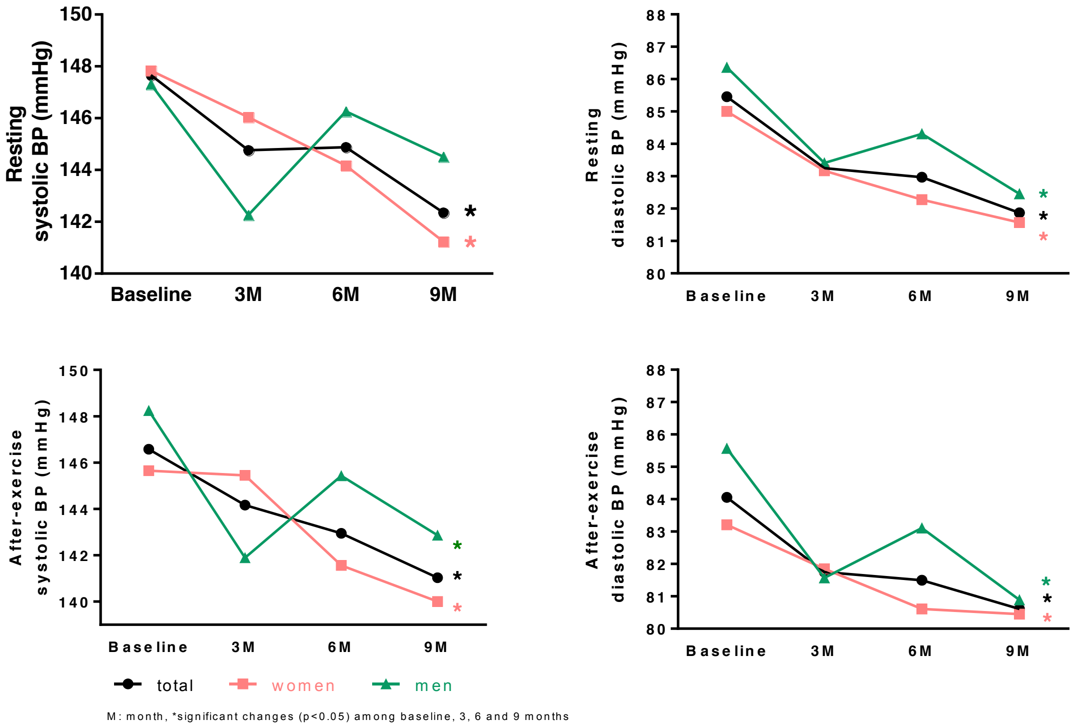
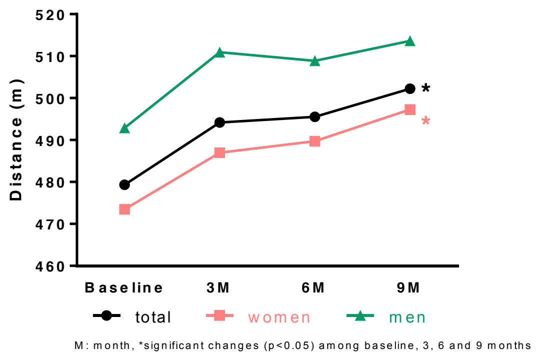


Figure 34. Mean changes in total distance along the program in total sample, women and men (Friedman´s ANOVA). Standard deviations are shown in Table 17 and 19.



4.4.2.2. Changes in physical measures by age

Tests performed in different age groups (Table 22 and Figures 35-38) showed significant changes ($p\leq0.04$) in weight and BMI in the 21-30 age group, in weight, BMI and flexibility in the 31-40 age group and in waist circumference and flexibility in the 41-50 age group. Also, the 51-60 age group showed changes in weight, BMI, WHR, flexibility, resting diastolic blood pressure and total distance and the 61-70 age group in weight, BMI, waist circumference, flexibility, resting systolic and diastolic blood pressure, after-exercise diastolic blood pressure and total distance. The 71-80 age group showed significant ($p\leq0.04$) changes in flexibility and resting diastolic blood pressure. Tests could not be performed in the 81-90 age group and in some of the physical measures in other age groups due to the null or low sample size ($n\leq1$).

Follow-up tests (Tables 23-26) showed that statistically significant ($p\leq0.05$) changes in weight and BMI in all age groups had effect sizes smaller than d=0.03. In the 21-30 decade group, changes in flexibility became significant after three months (11.82±7.75 - 13.89±7.84 cm, d=-0.26, p=0.03) and six months (8.50±6.06 - 10.81±6.99 cm, d= -0.35, p=0.04). No significant changes were found between baseline and nine months.

In the 31-40 age group, changes in flexibility were significant ($p\leq0.03$) in the three follow-ups but the largest effect size (d=-0.42) was found between baseline and the nine month measurement (Table 23).

In the 41-50 age group, only changes in flexibility (12.10±9.99 - 14.40±9.98 cm, d=-0.23, $p\leq0.001$) and total distance (498.62±50.63 - 515.24±54.07 m, d=-0.32, p=0.02) were significant between baseline and the three month measurement. Between baseline and six months, changes in waist circumference (97.25±9.05 – 94.62±8.89 cm, d=0.29, p=0.04) and in flexibility were significant (11.45±10.22 - 14.41±8.47 cm, d=-0.31, $p<0.001$). Between baseline and nine months only changes in flexibility were significant (15.38±10.25 - 17.90±8.88 cm, d=-0.26, $p<0.001$).

In the 51-60 age group, changes in flexibility, resting systolic and diastolic blood pressure, after-exercise diastolic blood pressure and total distance were significant ($p\leq0.04$) between baseline and three months (Table 24). Similar results were found between baseline and six months except in changes in resting systolic blood pressure. However, after-exercise systolic blood pressure became significant (p=0.004) at this time. In the last follow-up at nine months, changes in flexibility, in total distance and in all blood pressure measures were significant ($p\leq0.007$) with effect sizes greater than the previous follow-ups (Table 24).

In the 61-70 age group, significant ($p \le 0.02$) changes were found in flexibility, all the blood pressure measures and total distance between baseline and the other follow-ups. Changes in waist circumference were only significant at three months but had small effect size (98.40±11.86 – 97.95±11.77 cm, d=0.04, p=0.05). Effect sizes were highest between baseline and the nine month measurement in resting systolic blood pressure and total distance (Table 25). In the other variables the improvement reached a peak at six months and then stayed the same or even decreased (resting diastolic blood pressure from d=0.34 at six months to d=0.26 at nine months).

In the 71-80 age group, changes in flexibility, resting and after-exercise diastolic blood pressure and total distance were significant ($p \le 0.04$) between baseline and three months (Table 26). Resting systolic blood pressure was not statistically significant (p=0.06) but values showed possible important changes (148.37±13.33-144.85±15.39 mmHg). Between baseline and six months, changes in flexibility and resting systolic and diastolic blood pressure were significant ($p<0.001$). At nine months, changes in flexibility were the only significant ($p<0.001$) ones (Table 26).

Table 22. Changes in physical measures along the program in different age groups (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

21-30 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	6	63.96±16.93	63.72±16.78	63.75±17.52	65.25±17.66	10.39	**0.01**
BMI (kg/m²)	6	24.84±6.91	24.74±8.84	24.76±7.14	25.34±7.21	10.39	**0.01**
Waist circumference (cm)	1	107	106	109	109	.	.
Waist-hip ratio	1	.89	.88	.89	.88	.	.
Flexibility (cm)	2	12.00±1.41	17.50±0.7	16.50±4.95	19.00±1.41	4.16	0.24
Resting systolic BP (mmHg)	1	140.00	120.00	130.00	140.00	.	.
Resting diastolic BP (mmHg)	1	80.00	70.00	75.00	80.00	.	.
After-exercise systolic BP (mmHg)	1	120.00	130.00	130.00	130.00	.	.
After-exercise diastolic BP (mmHg)	1	80.00	70.00	75.00	70.00	.	.
Resting HR (bpm)	1	76.00	100.00	93.00	80.00	.	.
After-exercise HR (bpm)	1	139.00	142.00	147.00	125.00	.	.
Total distance in 6MW (m)	1	537.00	564.00	552.00	561.00	.	.
31-40 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	20	74.06±17.94	73.06±17.85	72.49±17.40	72.49±17.52	11.18	**0.01**
BMI (kg/m²)	20	26.32±5.88	25.98±5.92	25.79±5.86	25.78±5.84	11.18	**0.01**
Waist circumference (cm)	0	.	.	.	.	.	.
Waist-hip ratio	0	.	.	.	.	.	.
Flexibility (cm)	9	11.33±9.12	13.44±10.34	15.11±7.50	15.66±10.41	8.74	**0.03**
Resting systolic BP (mmHg)	0	.	.	.	.	.	.
Resting diastolic BP (mmHg)	0	.	.	.	.	.	.
After-exercise systolic BP (mmHg)	0	.	.	.	.	.	.
After-exercise diastolic BP (mmHg)	0	.	.	.	.	.	.
Resting HR (bpm)	0	.	.	.	.	.	.
After-exercise HR (bpm)	0	.	.	.	.	.	.
Total distance in 6MW (m)	0	.	.	.	.	.	.
41-50 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	103	68.98±12.75	68.52±12.57	68.52±12.66	68.27±12.85	7.29	0.06
BMI (kg/m²)	98	26.11±4.21	25.95±4.17	25.95±4.31	25.85±4.38	6.58	0.08
Waist circumference (cm)	6	99.50±9.46	97.83±11.25	96.00±10.04	96.16±8.63	8.14	**0.04**
Waist-hip ratio	5	0.91±0.04	0.9±0.02	0.89±0.03	0.89±0.03	5.67	0.13
Flexibility (cm)	44	15.32±10.28	17.40±10.72	16.45±8.67	17.18±9.20	14.29	**0.003**
Resting systolic BP (mmHg)	2	165±49.49	157.5±31.82	142.5±24.74	140±14.14	3.94	0.26
Resting diastolic BP (mmHg)	2	92.5±17.67	95±7.07	87.5±3.53	89±5.65	0.60	0.89
After-exercise systolic BP (mmHg)	2	175±70.71	160±42.42	142.5±31.82	146±19.79	1.80	0.61
After-exercise diastolic BP (mmHg)	2	95±21.21	87.5±3.53	85±7.07	88±2.82	1.40	0.71
Resting HR (bpm)	8	88.37±14.97	89.37±15.71	84.12±14.89	96.25±18.23	4.29	0.23
After-exercise HR (bpm)	8	122.87±11.61	115.5±21.48	110.75±22.54	118.75±15.94	6.58	0.08
Total distance in 6MW (m)	8	512.25±35.95	514.87±39.89	507.75±52.46	521.5±48.16	1.27	0.74

51-60 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	201	71.84±13.43	71.32±13.19	71.28±13.10	71.19±13.34	14.49	**0.002**
BMI (kg/m²)	198	28.95±5.20	28.73±5.09	28.71±5.03	28.68±5.13	14.07	**0.003**
Waist circumference (cm)	18	99.89±11.15	99.78±11.48	100.33±11.39	99.39±11.22	3.69	0.30
Waist-hip ratio	17	0.94±0.07	0.94±0.07	0.93±0.07	0.93±0.07	10.17	**0.02**
Flexibility (cm)	78	14.62±9.09	17.01±9.11	17.69±6.92	18.53±7.18	58.54	**<0.001**
Resting systolic BP (mmHg)	32	143.78±12.52	144.12±12.74	142.43±14.24	138.62±15.39	2.46	0.48
Resting diastolic BP (mmHg)	31	85.87±5.32	84.29±5.83	83.58±7.97	81.22±7.24	9.01	**0.03**
After-exercise systolic BP (mmHg)	28	144.14±9.70	143.14±11.23	140.25±14.76	139.75±8.87	4.46	0.21
After-exercise diastolic BP (mmHg)	28	84.18±6.15	82.21±6.61	82.21±7.56	81.82±6.04	1.84	0.61
Resting HR (bpm)	31	74.52±11.90	74.19±13.72	76.26±12.67	74.35±13.63	1.93	0.58
After-exercise HR (bpm)	31	96.26±12.93	94.09±14.41	95.61±15.07	98.93±14.27	3.99	0.26
Total distance in 6MW (m)	30	485.36±57.26	509.83±56.08	515.76±57.71	528.23±56.02	19.49	**<0.001**
61-70 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	167	72.72±13.16	72.05±12.99	72.04±13.00	71.99±13.28	26.62	**<0.001**
BMI (kg/m²)	158	29.18±4.67	28.92±4.56	28.91±4.56	28.89±4.67	26.94	**<0.001**
Waist circumference (cm)	21	101.33±14.87	100.09±14.78	99.81±14.30	99.52±14.62	17.51	**<0.001**
Waist-hip ratio	21	0.91±0.08	0.91±0.09	0.91±0.08	0.91±0.08	2.60	0.45
Flexibility (cm)	44	11.81±9.65	14.48±10.17	16.18±9.34	17.05±8.12	43.06	**<0.001**
Resting systolic BP (mmHg)	55	148.76±14.34	143.96±12.24	147.02±13.46	142.67±14.02	10.68	**0.01**
Resting diastolic BP (mmHg)	56	85.71±6.41	82.53±6.78	84.02±6.64	83.14±9.77	14.01	**0.003**
After-exercise systolic BP (mmHg)	51	144.96±15.61	142.08±12.88	143.12±11.82	139.49±13.19	6.50	0.09
After-exercise diastolic BP (mmHg)	51	83.88±7.72	81.53±6.42	81.21±6.63	79.98±7.99	13.21	**0.004**
Resting HR (bpm)	30	72.4±10.86	72.7±9.28	73.73±11.46	70.8±12.07	4.40	0.22
After-exercise HR (bpm)	30	94.56±17.34	92.5±13.28	96.56±17.82	92.36±15.29	1.57	0.66
Total distance in 6MW (m)	30	468.9±71.97	477.3±51.14	484.56±53.01	487.6±62.53	12.99	**0.005**
71-80 age group	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	85	69.92±10.62	69.77±10.90	69.85±10.59	69.84±10.48	1.65	0.65
BMI (kg/m²)	81	28.18±3.65	28.12±3.72	28.17±3.69	28.15±3.68	1..54	0.67
Waist circumference (cm)	11	95.27±10.69	95.54±10.25	95.91±10.20	95.64±9.97	1.80	0.61
Waist-hip ratio	10	0.92±0.06	0.92±0.05	0.92±0.05	0.92±0.05	1.34	0.72
Flexibility (cm)	23	11.66±8.53	12.98±8.42	15.02±6.80	14.81±6.96	19.25	**<0.001**
Resting systolic BP (mmHg)	25	149.12±10.62	147.28±11.57	144.08±12.28	146.68±14.31	2.17	0.54
Resting diastolic BP (mmHg)	25	84.04±6.35	83.16±6.51	79.8±6.55	79.32±6.88	7.94	**0.04**
After-exercise systolic BP (mmHg)	21	152.33±17.06	149.81±16.55	146.81±12.29	146.52±14.81	2.98	0.39
After-exercise diastolic BP (mmHg)	21	83.48±5.75	81.66±7.16	81.24±4.97	80.33±6.31	3.75	0.29
Resting HR (bpm)	16	73.81±13.12	73.56±12.30	74.37±13.08	69.12±14.31	3.23	0.36
After-exercise HR (bpm)	16	94.44±18.13	94.12±10.86	95.69±12.05	89.19±13.16	2.86	0.41
Total distance in 6MW (m)	16	471.19±42.39	484.81±46.88	475.25±53.45	473.31±53.85	6.17	0.11

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

Table 23. Changes in flexibility between baseline, 3, 6 and 9 months in the 31-40 decade group (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

n	Baseline	3 month	p	d
78	12.90±8.45	14.55±8.94	**<0.00***	-0.19
n	Baseline	6 months		
35	13.05±9.15	15.87±9.41	**0.003**	-0.30
n	Baseline	9 month		
12	10.75±7.99	14.42±9.18	**0.03**	-0.42

n: number of individuals, p: significance value, d: effect size (Cohen´s d)

Table 24. Significant changes in measures between baseline and 3, 6 and 9 months in the 51-60 age group (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Flexibility (cm)	349	12.03±9.46	14.48±9.63	**<0.001**	-0.26
Resting systolic BP (mmHg)	130	144.23±15.29	140.05±16.06	**<0.001**	0.27
Resting diastolic BP (mmHg)	129	85.14±6.85	83.95±6.67	**0.04**	0.17
After-exercise systolic BP (mmHg)	119	141.30±13.32	140.80±14.19	0.260	0.03
After-exercise diastolic BP (mmHg)	119	83.82±6.59	82.30±7.09	**0.02**	0.22
Total distance in 6MW (m)	76	487.72±64.47	507.97±55.70	**<0.001**	-0.34
	n	Baseline	6 month	p	d
Flexibility (cm)	249	12.48±9.66	15.70±8.61	**<0.001**	-0.35
Resting systolic BP (mmHg)	79	144.09±16.19	141.86±13.18	0.33	0.15
Resting diastolic BP (mmHg)	79	85.58±6.97	83.49±7.09	**0.04**	0.30
After-exercise systolic BP (mmHg)	69	143.16±17.50	138.16±13.05	**0.004**	0.32
After-exercise diastolic BP (mmHg)	69	84.23±8.13	81.39±6.94	**0.01**	0.37
Total distance in 6MW (m)	45	475.35±62.05	509.44±57.99	**<0.001**	-0.57
	n	Baseline	9 month	p	d
Flexibility (cm)	139	13.40±9.61	17.09±8.01	**<0.001**	-0.42
Resting systolic BP (mmHg)	58	145.38±11.97	139.19±12.66	**0.007**	0.50
Resting diastolic BP (mmHg)	57	86.63±6.09	82.18±6.53	**<0.001**	0.70
After-exercise systolic BP (mmHg)	51	144.94±12.59	139.10±8.95	**0.005**	0.53
After-exercise diastolic BP (mmHg)	51	86.75±15.96	81.55±6.01	**0.005**	0.43
Total distance in 6MW (m)	36	481.86±56.48	520.81±54.81	**<0.001**	-0.70

n: number of individuals, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

Table 25. Significant changes in measures between baseline and 3, 6 and 9 months in the 61-70 age group (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Flexibility (cm)	240	10.71±9.78	12.94±10.00	**<0.001**	-0.22
Resting systolic BP (mmHg)	180	148.16±14.71	145.28±15.33	**0.003**	0.19
Resting diastolic BP (mmHg)	180	85.02±7.73	82.76±8.06	**<0.001**	0.28
After-exercise systolic BP (mmHg)	163	146.23±16.94	143.15±15.14	**<0.001**	0.19
After-exercise diastolic BP (mmHg)	163	83.28±8.03	81.28±7.89	**<0.001**	0.25
Total distance in 6MW (m)	89	473.53±58.81	489.15±51.86	**<0.001**	-0.28
	n	Baseline	6 month	p	d
Flexibility (cm)	177	10.55±9.37	14.53±8.56	**<0.001**	-0.44
Resting systolic BP (mmHg)	129	147.60±13.37	144.50±13.89	**0.02**	0.23
Resting diastolic BP (mmHg)	129	85.62±6.72	83.09±8.01	**<0.001**	0.34
After-exercise systolic BP (mmHg)	121	146.41±15.03	141.58±12.46	**<0.001**	0.35
After-exercise diastolic BP (mmHg)	121	84.29±7.13	81.35±8.15	**<0.001**	0.38
Total distance in 6MW (m)	52	474.75±66.93	492.91±56.45	**0.005**	-0.29
	n	Baseline	9 month	p	d
Flexibility (cm)	90	12.00±10.71	16.38±9.04	**<0.001**	-0.44
Resting systolic BP (mmHg)	92	150.09±14.47	144.23±14.57	**<0.001**	0.40
Resting diastolic BP (mmHg)	93	85.32±6.79	83.12±9.74	**0.002**	0.26
After-exercise systolic BP (mmHg)	86	145.78±14.36	141.36±14.24	**0.002**	0.31
After-exercise diastolic BP (mmHg)	86	83.22±7.45	80.16±8.64	**<0.001**	0.38
Total distance in 6MW (m)	44	469.43±64.99	489.45±54.87	**<0.001**	-0.33

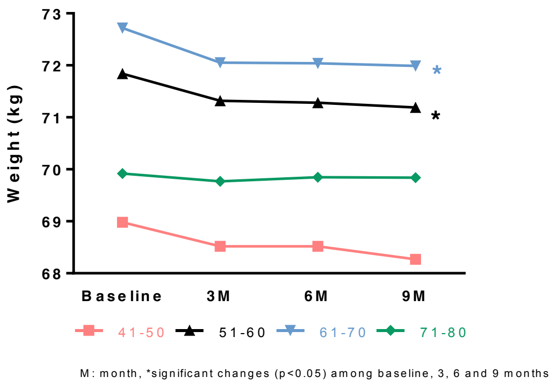
n: number of individuals, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

Table 26. Significant changes in measures between baseline and 3, 6 and 9 months in the 71-80 age group (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

	n	Baseline	3 month	p	d
Flexibility (cm)	94	8.70±9.12	10.91±9.12	**<0.001**	-0.24
Resting systolic BP (mmHg)	81	148.37±13.33	144.85±15.39	0.06	0.24
Resting diastolic BP (mmHg)	80	82.98±7.46	80.91±7.99	**0.04**	0.27
After-exercise systolic BP (mmHg)	78	148.47±16.46	145.95±16.45	0.12	0.15
After-exercise diastolic BP (mmHg)	78	82.40±6.36	80.41±7.32	**0.02**	0.29
Total distance in 6MW (m)	47	449.27±61.55	461.70±59.47	**0.04**	-0.20
	n	Baseline	6 month	p	d
Flexibility (cm)	65	9.75±8.67	12.58±8.82	**<0.001**	-0.32
Resting systolic BP (mmHg)	62	147.29±11.71	141.66±10.95	**<0.001**	0.49
Resting diastolic BP (mmHg)	62	84.35±6.27	80.08±7.05	**<0.001**	0.64
After-exercise systolic BP (mmHg)	58	146.86±14.97	145.22±11.22	0.41	0.12
After-exercise diastolic BP (mmHg)	58	82.36±6.42	81.12±5.91	0.27	0.20
Total distance in 6MW (m)	31	459.77±55.53	459.09±67.65	0.74	0.01
	n	Baseline	9 month	p	d
Flexibility (cm)	41	10.91±9.71	13.76±7.92	**<0.001**	-0.32
Resting systolic BP (mmHg)	45	147.51±10.82	147.16±12.49	0.99	0.03
Resting diastolic BP (mmHg)	45	83.09±6.89	81.07±7.35	0.29	0.28
After-exercise systolic BP (mmHg)	41	149.00±15.12	145.20±12.45	0.18	0.27
After-exercise diastolic BP (mmHg)	41	82.61±5.68	80.66±6.68	0.18	0.31
Total distance in 6MW (m)	22	462.50±51.81	468.95±55.48	0.42	-0.12

n: number of individuals, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

Figure 35. Mean changes in weight and BMI in different age groups (Friedman´s ANOVA). Standard deviations are shown in Table 22.



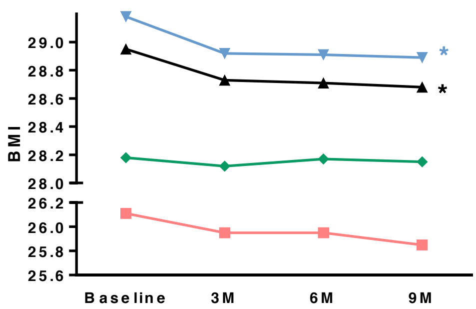
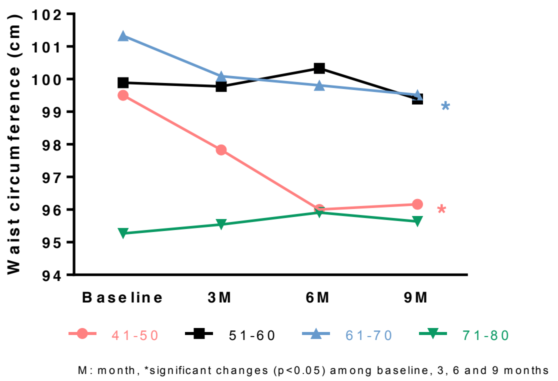


Figure 36. Mean changes in waist circumference and flexibility in different age groups (Friedman´s ANOVA). Standard deviations are shown in Table 22.



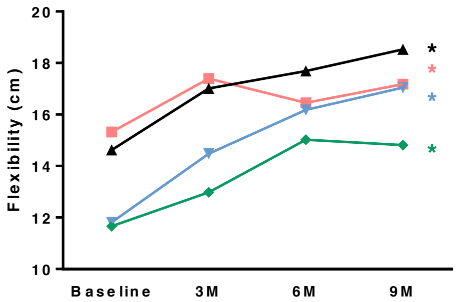


Figure 37. Mean changes in total distance in different age groups (Friedman´s ANOVA). Standard deviations are shown in Table 22.

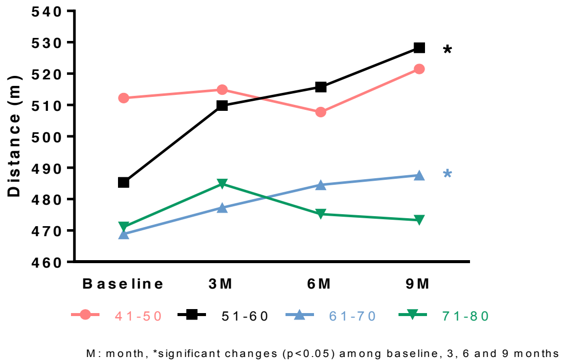
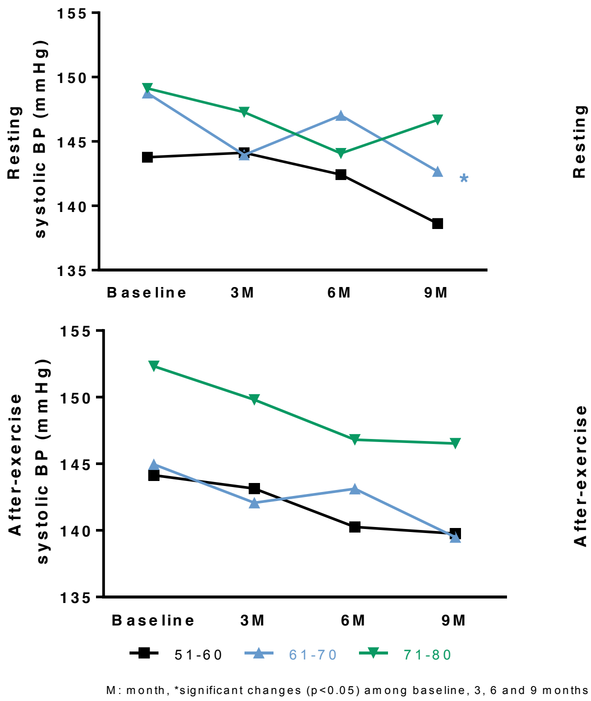


Figure 38. Mean changes in blood pressure measures in different age groups (Friedman´s ANOVA). Standard deviations are shown in Table 22.



4.4.2.3. Changes in physical measures by diagnosis

As mentioned before, considering the significant differences observed previously between men and women, changes in physical measures in different diagnose groups were also divided by gender (see Tables 27-30 and Figures 39-43).

For the MSD group, both women and men showed significant (p≤0.01) differences in weight, BMI and flexibility along the program (Table 27).

Follow-up tests showed that in women, changes in weight and BMI between baseline and the three other follow-ups were significant (p≤0.04). However, effect sizes of these changes were very small (d<0.04) (Table 28). Changes in flexibility were also significant (p<0.001) in all follow-ups and the highest effect size (d=-0.34) was reached by the six month follow-up (12.06±9.79 - 15.20±8.69 cm) staying constant until the next follow-up (d=-0.34). Changes in total distance were also significant (p=0.01) between baseline and three months (474.14±53.81 -487.76±55.41 m, d=-0.25) but not between baseline and the rest follow-ups. Changes in resting diastolic and after-exercise systolic blood pressure were also found significant (p≤0.04) only after six months (Table 28).

Table 27. Changes in physical measures along the program in the MSD group in women and in men (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	315	65.46±10.04	64.99±9.79	65.01±9.85	64.94±10.15	25.08	**<0.001**
BMI (kg/m²)	300	26.58±3.92	26.40±3.81	26.39±3.82	26.37±3.96	23.29	**<0.001**
Waist circumference (cm)	1	107	101	100	100	.	.
Waist-hip ratio	1	0.90	0.89	0.90	0.90	.	.
Flexibility (cm)	149	14.59±8.98	16.86±9.22	17.42±7.69	18.03±8.04	89.66	**<0.001**
Resting systolic BP (mmHg)	7	140±15.27	145±5.0	138±11.49	133±7.55	5.37	0.15
Resting diastolic BP (mmHg)	7	82±6.36	85±5.0	80±6.45	79±4.49	2.06	0.56
After-exercise systolic BP (mmHg)	6	138±12.91	142±7.52	134±9.17	133±8.75	5.24	0.16
After-exercise diastolic BP (mmHg)	6	80±8.36	85±5.47	79±5.84	80±6.32	4.16	0.25
Resting HR (bpm)	2	73±9.19	78±21.92	82±21.92	73±18.38	3.32	0.35
After-exercise HR (bpm)	2	88±12-02	86±7.07	96±3.53	83±0.00	1.80	0.62
Total distance in 6MW (m)	2	503.5±38.89	507±32.52	541.5±23.33	534.5±50.20	4.80	0.19

Men	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	71	79.62±10.37	79.02±10.29	78.87±10.09	78.79±10.44	11.90	**0.01**
BMI (kg/m²)	71	27.11±2.87	26.91±2.87	26.87±2.89	26.84±3.03	11.90	**0.01**
Waist circumference (cm)	1	112	112	113	112	.	.
Waist-hip ratio	1	1.06	1.06	1.05	1.05	.	.
Flexibility (cm)	26	10.10±9.20	13.09±10.05	12.35±7.97	13.96±7.22	20.81	**<0.001**
Resting systolic BP (mmHg)	2	150±14.14	142±3.53	142±10.60	152±3.53	1.67	0.64
Resting diastolic BP (mmHg)	2	90±0.00	85±7.07	85±7.07	92±3.53	3.00	0.39
After-exercise systolic BP (mmHg)	2	145±7.07	127±10.60	140±0.00	142±3.53	5.25	0.15
After-exercise diastolic BP (mmHg)	2	87±3.53	75±7.07	82±3.53	85±7.07	3.00	0.39
Resting HR (bpm)	2	77±15.55	65±4.95	62±3.53	62±0.07	3.95	0.27
After-exercise HR (bpm)	2	98±14.14	85±11.31	75±15.55	87±2.82	3.60	0.31
Total distance in 6MW (m)	2	518.5±47.37	496.5±74.24	479±101.82	483±74.95	4.20	0.24

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

In men, changes in weight and BMI showed to be significant (p<0.001) after three months, but similarly to women, effect sizes were very small (d<0.03)(Table 28). Changes in flexibility were also significant (p<0.001) in all follow-ups and the highest effect size was reached at the nine month measurement (7.93±9.07-12.09±9.10 cm, d=-0.46). After-exercise systolic blood pressure significantly (p=0.03) decreased at three months and at six months but not at nine months (Table 28). The greatest effect size was reached at six months (146.36±14.33- 137.73±10.33 mmHg, d=0.69).

Table 28. Changes in physical measures between baseline and 3, 6 and 9 months in the MSD group in women and men (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	p	d
Weight (kg)	976	65.08±10.07	64.69±9.91	**<0.001**	0.04
BMI (kg/m²)	936	26.26±4.08	26.11±4.02	**<0.001**	0.04
Flexibility (cm)	694	12.29±9.45	14.57±9.49	**<0.001**	-0.24
Resting diastolic BP (mmHg)	27	83.48±8.02	83.00±7.09	0.85	0.06
After-exercise systolic BP (mmHg)	24	137.33±14.45	138.46±14.11	0.63	-0.08
Total distance in 6MW (m)	21	474.14±53.81	487.76±55.41	**0.01**	-0.25
	n	Baseline	6 month	p	d
Weight (kg)	797	65.55±9.96	65.15±9.77	**<0.001**	0.04
BMI (kg/m²)	752	26.54±3.86	26.36±3.77	**<0.001**	0.05
Flexibility (cm)	497	12.06±9.79	15.20±8.69	**<0.001**	-0.34
Resting diastolic BP (mmHg)	18	85.44±7.07	82.06±6.79	**0.03**	0.49
After-exercise systolic BP (mmHg)	14	142.50±12.67	138.57±9.69	**0.04**	0.35
Total distance in 6MW (m)	2	503.50±38.89	541.50±23.33	0.18	-1.18
	n	Baseline	9 month	p	d
Weight (kg)	507	65.31±10.14	64.92±10.10	**0.004**	0.04
BMI (kg/m²)	480	26.53±4.07	26.37±4.05	**0.003**	0.04
Flexibility (cm)	259	14.40±9.75	17.79±7.99	**<0.001**	-0.38
Resting diastolic BP (mmHg)	15	84.00±7.37	84.00±9.67	0.84	0.00
After-exercise systolic BP (mmHg)	12	140.42±13.39	142.50±18.28	0.76	-0.13
Total distance in 6MW (m)	2	503.50±38.89	534.50±50.20	0.18	-0.69
Men	n	Baseline	3 month	p	d
Weight (kg)	256	78.11±10.23	77.77±10.26	**<0.001**	0.03
BMI (kg/m²)	243	26.47±3.09	26.35±3.09	**<0.001**	0.04
Flexibility (cm)	160	9.10±9.26	11.33±9.95	**<0.001**	-0.23
After-exercise systolic BP (mmHg)	14	148.64±14.07	140.71±11.74	**0.03***	0.61
	n	Baseline	6 month	p	d
Weight (kg)	185	78.90±11.19	78.58±11.26	0.06	0.03
BMI (kg/m²)	174	26.71±3.25	26.59±3.26	**0.05**	0.04
Flexibility (cm)	84	9.20±8.42	11.79±8.36	**<0.001**	-0.31
After-exercise systolic BP (mmHg)	11	146.36±14.33	137.73±10.33	**0.02**	0.69
	n	Baseline	9 month	p	d
Weight (kg)	112	77.71±10.38	77.27±10.21	0.14	0.04
BMI (kg/m²)	106	26.59±3.11	26.43±3.14	0.09	0.05
Flexibility (cm)	46	7.93±9.07	12.09±9.10	**<0.001**	-0.46
After-exercise systolic BP (mmHg)	3	143.33±5.77	141.67±2.89	0.32	0.36

n: number of individuals, BMI: body max index, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

In the diabetes group, only women showed significant (p=0.05) changes and only in resting systolic blood pressure (Table 29). However, follow-up tests also showed significant (p≤0.02) changes in weight and BMI between baseline and three months (Table 30). Effect sizes of these changes were small (d<0.04). Changes in total distance were found significant (p≤0.04) in all measurements with the highest effect size occurring at nine months (d=-1-01) (Table 30). Changes in flexibility showed also to be significant (p=0.04) at six months and after exercise systolic blood pressure at nine months (Table 30).

Table 29. Changes in physical measures along the program in the diabetes group in women and in men (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	16	75.41±12.89	74.45±12.40	74.76±12.32	74.70±12.34	5.84	0.12
BMI (kg/m²)	16	31.43±5.29	31.02±5.04	31.15±5.04	31.11±4.99	5.84	0.12
Waist circumference (cm)	4	94.50±10.66	95.25±10.76	95.00±9.79	94.75±10.40	1.21	0.75
Waist-hip ratio	3	0.93±0.02	0.90±0.03	0.91±0.02	0.90±0.01	2.04	0.57
Flexibility (cm)	.	.	.	.	.	.	.
Resting systolic BP (mmHg)	3	150±10.0	137±5.77	133±5.77	142±2.88	7.96	**0.05**
Resting diastolic BP (mmHg)	3	87±2.88	82±7.63	77±5.77	80±5.00	4.78	0.19
After-exercise systolic BP (mmHg)	3	140±17.32	140±10.00	137±5.77	133±5.77	2.29	0.51
After-exercise diastolic BP (mmHg)	3	80±10.00	78±7.63	80±0.00	80±0.00	0.14	0.99
Resting HR (bpm)	6	87±15.22	80±16-13	82±16.26	90±21.51	4.90	0.18
After-exercise HR (bpm)	6	112±20.63	108±21.14	111±22.51	115±24.52	3.00	0.39
Total distance in 6MW (m)	6	454.3±38.31	483±47.09	478.83±26.92	491.67±63.37	6.60	0.09

Men	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	12	78.94±15.56	78.35±14.91	78.40±14.70	79.10±15.03	1.94	0.59
BMI (kg/m²)	11	29.70±6.80	29.44±6.47	29.45±6.39	29.65±6.53	1.24	0.74
Waist circumference (cm)	2	114.00±0.00	113.50±0.71	113.50±0.71	114.00±1.41	2.00	0.57
Waist-hip ratio	2	1.05±0.07	1.04±0.81	1.04±0.08	1.04±0.07	4.00	0.26
Flexibility (cm)	1	21	20	19	19	3.00	0.39
Resting systolic BP (mmHg)	1	168	165	163	143	3.00	0.39
Resting diastolic BP (mmHg)	1	92	88	84	80	3.00	0.39
After-exercise systolic BP (mmHg)	1	168	169	170	136	3.00	0.39
After-exercise diastolic BP (mmHg)	1	86	88	88	81	3.00	0.39
Resting HR (bpm)	2	75±30.30	78±35.35	76±33.94	71±26.87	3.63	0.30
After-exercise HR (bpm)	2	87±24.74	94±24.74	97±24.74	102±31.82	5.84	0.12
Total distance in 6MW (m)	2	483.5±19.09	536.5±6.36	544±5.65	516±48.08	2.40	0.49

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

Table 30. Changes in physical measures between baseline and 3, 6 and 9 months in the diabetes group in women (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	p	d
Weight (kg)	60	72.67±11.46	72.24±11.45	**0.01**	0.04
BMI (kg/m²)	56	30.82±4.94	30.64±4.87	**0.02**	0.04
Waist-hip ratio	8	0.93±0.05	0.91±0.05	0.35	0.40
Flexibility (cm)	8	13.13±6.17	15.13±7.02	0.07	-0.30
After-exercise systolic BP (mmHg)	20	143.35±15.22	144.75±17.38	0.96	-0.08
Total distance in 6MW (m)	15	461.00±59.31	481.13±60.05	**0.02**	-0.34
	n	Baseline	6 month	p	d
Weight (kg)	52	73.19±13.84	73.23±13.92	0.79	0.00
BMI (kg/m²)	48	31.18±5.54	31.22±5.53	1	0.00
Waist-hip ratio	6	0.91±0.06	0.88±0.06	0.32	0.50
Flexibility (cm)	5	10.90±7.30	15.60±8.35	**0.04**	-0.60
After-exercise systolic BP (mmHg)	14	140.36±16.23	137.86±14.10	0.39	0.16
Total distance in 6MW (m)	12	462.67±53.25	496.08±40.13	**0.02**	-0.71
	n	Baseline	9 month	p	d
Weight (kg)	26	75.59±13.23	75.26±13.31	0.38	0.02
BMI (kg/m²)	24	31.68±5.17	31.53±5.18	0.37	0.03
Waist-hip ratio	5	0.95±0.05	0.91±0.04	0.08	0.88
Flexibility (cm)	3	9.67±6.66	10.67±6.43	1	-0.15
After-exercise systolic BP (mmHg)	10	136.10±12.82	130.10±9.07	**0.04**	0.54
Total distance in 6MW (m)	9	440.88±41.59	488.00±51.03	**0.04**	-1.01

n: number of individuals, BMI: body max index, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

In the hypertension group (Table 31), women showed significant ($p \leq 0.05$) changes in waist circumference, flexibility, resting diastolic blood pressure, after-exercise systolic and diastolic blood pressure and total distance, and men showed significant ($p \leq 0.03$) changes in resting diastolic, after-exercise systolic and diastolic blood pressure and total distance along the program.

Follow-up tests showed that in women, similar to other diagnose groups, changes in weight and BMI were statistically significant ($p \leq 0.01$) but effect sizes were small ($d < 0.02$) (Table 32). Significant changes ($p \leq 0.01$) were also found in flexibility, resting systolic and diastolic blood pressure, after-exercise systolic and diastolic blood pressure and total distance between baseline and all three follow-ups. Waist circumference did not show significant changes. Most of the variables, except resting and after-exercise diastolic blood pressure, reached their highest effect size at nine months (Table 32).

Table 31. Changes in physical measures along the program in the hypertension group in women and in men (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	96	73.76±13.84	73.39±13.84	73.50±13.72	73.26±13.53	5.53	0.14
BMI (kg/m²)	93	31.05±5.66	30.89±5.65	30.96±5.66	30.84±5.62	6.69	0.08
Waist circumference (cm)	26	95.19±12.76	95.04±12.56	95.11±12.22	94.08±11.43	12.84	**0.005**
Waist-hip ratio	25	0.88±0.05	0.88±0.05	0.88±0.05	0.87±0.05	4.70	0.20
Flexibility (cm)	19	10.42±11.57	12.00±11.60	16.71±7.92	16.95±7.88	32.63	**<0.001**
Resting systolic BP (mmHg)	66	149±14.17	147±14.0	145±14.14	142±15.00	6.91	0.08
Resting diastolic BP (mmHg)	66	85±6.79	83±6.78	83±7.68	82±9.30	13.53	**0.004**
After-exercise systolic BP (mmHg)	57	147±18.46	146±13.63	143±13.25	141±11.88	7.81	**0.05**
After-exercise diastolic BP (mmHg)	57	84±7.71	82±6.62	81±6.57	81±6.33	10.69	**0.01**
Resting HR (bpm)	37	75±9.95	76±10.69	76±11.98	74±12.21	3.97	0.27
After-exercise HR (bpm)	37	99±14.14	97±10.10	101±13.88	98±12.20	2.07	0.56
Total distance in 6MW (m)	37	466.62±63.70	478.35±48.82	480.67±51.20	486.86±56.08	9.32	**0.03**
Men	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	34	82.15±9.72	81.92±9.78	81.55±9.79	81.61±9.92	0.52	0.91
BMI (kg/m²)	32	29.74±3.45	29.65±3.49	29.52±3.47	29.55±3.49	0.78	0.86
Waist circumference (cm)	9	106.55±13.26	106.33±13.23	106.11±13.50	106.44±13.83	1.53	0.67
Waist-hip ratio	9	1.01±0.04	1.02±0.04	1.02±0.04	1.01±0.04	0.71	0.87
Flexibility (cm)	3	11.50±14.39	12.33±14.15	13.83±11.55	12.67±10.11	1.07	0.78
Resting systolic BP (mmHg)	36	147±13.73	142±11.13	146±12.96	144±15.18	3.26	0.35
Resting diastolic BP (mmHg)	36	86±5.71	83±7.10	84±6.21	82±8.06	10.07	**0.02**
After-exercise systolic BP (mmHg)	34	148±14.81	142±15.51	145±13.24	143±15.08	9.01	**0.03**
After-exercise diastolic BP (mmHg)	34	85±6.13	82±6.72	83±6.92	81±9.08	12.86	**0.005**
Resting HR (bpm)	20	68±10.72	67±10.82	70±8.61	65±9.84	5.89	0.12
After-exercise HR (bpm)	20	88±16.42	84±13.30	87±13.92	87±14.07	0.56	0.91
Total distance in 6MW (m)	20	487±64.64	502.5±54.36	503.25±68.17	511.3±71.98	8.70	**0.03**

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

In men, changes in flexibility were significant (p≤0.03) at three months and six months with the highest effect size reached at six months (6.16±10.60- 12.73±8.80 cm, d=-0.67). Changes in resting systolic blood pressure were only significant (p<0.001) after three months, changes in resting diastolic blood pressure were significant (p≤0.03) in all follow-ups and the highest effect size was reached at nine months (85.21±6.36 - 82.28±8.13 mmHg, p=0.40). Changes in after-exercise diastolic blood pressure were also significant (p=0.01) at three months and at nine months with the highest effect size at nine months (d=0.45) and total distance also significantly (p≤0.03) increased in all follow-ups with the highest effect size at nine months (d=-0.39)(Table 32).

Table 32. Changes in physical measures between baseline and 3, 6 and 9 months in the hypertension group in women and men (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	p	d
Weight (kg)	263	73.34±12.06	73.03±12.09	**<0.001**	0.02
BMI (kg/m²)	252	30.54±4.84	30.41±4.85	**<0.001**	0.03
Flexibility (cm)	79	10.16±9.86	12.70±10.07	**<0.001**	-0.25
Resting systolic BP (mmHg)	235	147.77±15.46	143.26±17.02	**<0.001**	0.28
Resting diastolic BP (mmHg)	233	84.64±7.60	82.36±7.84	**<0.001**	0.29
After-exercise systolic BP (mmHg)	213	145.83±17.14	142.97±15.56	**<0.001**	0.17
After-exercise diastolic BP (mmHg)	213	83.33±7.42	80.65±7.46	**<0.001**	0.36
Total distance in 6MW (m)	104	462.26±58.00	473.56±50.09	**<0.001**	-0.21
	n	Baseline	6 month	p	d
Weight (kg)	228	74.00±12.56	73.65±12.53	**0.01**	0.03
BMI (kg/m²)	216	30.84±5.17	30.69±5.16	**0.02**	0.03
Flexibility (cm)	55	10.58±9.05	15.73±8.55	**<0.001**	-0.58
Resting systolic BP (mmHg)	168	147.63±14.95	142.24±13.33	**<0.001**	0.38
Resting diastolic BP (mmHg)	168	85.46±7.00	82.20±7.84	**<0.001**	0.44
After-exercise systolic BP (mmHg)	153	146.27±18.04	140.71±13.45	**<0.001**	0.35
After-exercise diastolic BP (mmHg)	153	83.94±7.56	80.28±7.04	**<0.001**	0.50
Total distance in 6MW (m)	63	460.03±59.84	473.60±59.89	**0.004**	-0.23
	n	Baseline	9 month	p	d
Weight (kg)	146	73.72±13.43	73.31±13.25	0.15	0.03
BMI (kg/m²)	138	30.66±5.36	30.52±5.33	0.20	0.03
Flexibility (cm)	30	10.33±10.31	16.44±7.46	**<0.001**	-0.68
Resting systolic BP (mmHg)	115	149.97±13.69	143.70±14.20	**<0.001**	0.45
Resting diastolic BP (mmHg)	115	85.37±7.11	82.37±8.89	**<0.001**	0.37
After-exercise systolic BP (mmHg)	101	147.84±16.62	141.48±11.36	**<0.001**	0.45
After-exercise diastolic BP (mmHg)	101	83.71±7.64	80.67±6.86	**<0.001**	0.42
Total distance in 6MW (m)	49	462.47±61.85	483.00±54.78	**<0.001**	-0.35
Men	n	Baseline	3 month	p	d
Flexibility (cm)	24	3.24±10.63	4.65±10.50	**0.004**	-0.13
Resting systolic BP (mmHg)	104	146.59±14.57	142.39±12.62	**<0.001**	0.31
Resting diastolic BP (mmHg)	104	85.40±7.69	83.43±7.67	**0.02**	0.26
After-exercise systolic BP (mmHg)	99	144.62±16.15	143.69±15.48	0.23	0.06
After-exercise diastolic BP (mmHg)	99	84.02±7.61	82.28±7.61	**0.01**	0.23
Total distance in 6MW (m)	58	486.01±70.67	509.46±59.88	**<0.001**	-0.36
	n	Baseline	6 month	p	d
Flexibility (cm)	13	6.16±10.60	12.73±8.80	**0.03**	-0.67
Resting systolic BP (mmHg)	67	145.06±13.39	143.69±13.12	0.35	0.10
Resting diastolic BP (mmHg)	67	85.75±7.36	83.70±7.68	**0.03**	0.27
After-exercise systolic BP (mmHg)	64	144.14±14.87	142.67±12.20	0.51	0.11
After-exercise diastolic BP (mmHg)	64	84.27±6.92	83.20±7.99	0.25	0.14
Total distance in 6MW (m)	34	487.38±68.66	509.35±68.44	**0.03**	-0.32
	n	Baseline	9 month	p	d
Flexibility (cm)	6	4.67±15.61	4.58±15.28	0.92	0.00
Resting systolic BP (mmHg)	53	147.11±13.36	144.11±14.09	0.18	0.22
Resting diastolic BP (mmHg)	53	85.21±6.36	82.28±8.13	**0.02**	0.40
After-exercise systolic BP (mmHg)	52	146.48±13.72	143.46±14.40	0.14	0.21
After-exercise diastolic BP (mmHg)	52	84.23±6.48	80.81±8.41	**0.01**	0.45
Total distance in 6MW (m)	24	486.12±60.24	511.00±67.45	**0.01**	-0.39

n: number of individuals, BMI: body max index, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, p: significance value, d: effect size (Cohen´s d)

Patients in the hypertension group under hypertensive medication (65.2%) showed more changes in physical measures than the non-medicated ones (Table 33). Patients with medication improved their waist circumference, flexibility, resting systolic and diastolic blood pressure, after-exercise diastolic blood pressure and total distance. Non-medicated patients showed significant ($p \leq 0.003$) changes in flexibility and in resting and after-exercise diastolic blood pressure.

Table 33. Changes in physical measures along the program in medicated and non-medicated patients in the hypertension group (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Medication	n	Baseline	3 month	6 month	9 month	X^2_F	p
Waist circumference (cm)	28	99.64±14.03	99.35±13.99	99.25±13.77	98.46±13.48	15.13	**0.002**
Flexibility (cm)	10	12.85±10.87	14.40±11.13	15.80±9.98	15.21±9.83	17.64	**<0.001**
Resting systolic BP	74	148.68±12.23	144.30±12.31	145.47±12.93	141.39±15.33	12.16	**0.007**
Resting diastolic BP	74	85.12±6.15	82.51±6.81	83.61±6.67	81.91±9.47	18.36	**<0.001**
After-exercise systolic BP	68	146.93±15.03	144.44±14.20	144.18±12.25	141.90±13.26	4.09	0.25
After-exercise diastolic BP	68	83.40±6.74	81.53±6.83	82.24±6.81	80.84±7.38	10.95	**0.01**
Total distance in 6MW(m)	46	466.39±65.20	481.54±53.72	483.30±58.27	491.04±64.22	19.28	**<0.001**
Non-medication	n	Baseline	3 month	6 month	9 month	X^2_F	p
Waist circumference (cm)	29	99.58±10.58	98.62±10.73	98.72±10.38	98.62±10.59	1.29	0.73
Flexibility (cm)	12	8.68±12.31	10.08±12.10	16.75±6.86	17.33±6.57	14.08	**0.003**
Resting systolic BP	28	145.75±17.91	146.21±15.54	145.82±15.73	146.57±13.72	0.31	0.96
Resting diastolic BP	28	86.50±7.08	84.64±6.90	82.50±8.53	81.93±7.09	8.05	**0.04**
After-exercise systolic BP	23	147.78±22.57	144.96±15.39	141.52±15.92	141.57±12.99	3.92	0.27
After-exercise diastolic BP	23	87.22±7.80	82.30±6.08	79.78±6.37	79.78±7.71	14.37	**0.002**
Total distance in 6MW(m)	11	504.72±51.54	508.90±36.06	510.72±54.58	513.81±54.10	1.91	0.59

n: number of individuals, BP: blood pressure, 6MW: six-minute walk test, mmHg: millimeter of mercury, X^2_F: Friedman´s ANOVA, p: significance value

When looking at changes in physical measures in different medication groups (Table 34), the ACEI group showed significant ($p \leq 0.05$) changes in waist circumference (97.57±12.67 cm at baseline, 95.14±10.67 cm at nine months), WHR (0.92±0.07 at baseline, 0.89±0.06 at nine months) and in after-exercise diastolic blood pressure (82.83±4.04 mmHg at baseline 81.08±6.93 mmHg at nine months). The Angiotensin receptor blocker group (ARB) showed significant ($p=0.03$) changes in resting diastolic blood pressure (83.63±5.07 mmHg at baseline, 78.50±4.69 mmHg at nine months). The rest of the medication groups did not show significant changes in any physical measures.

Table 34. Significance values (p values) of changes in physical measures along the program in different medication groups (Friedman´s ANOVA).

	ACEI$_1$	Diuretics$_2$	ARB$_3$	Beta-B$_4$	Ca blockers$_5$
Waist circumference (cm)	**0.05***	0.24	0.16	.	.
Waist-hip ratio	**0.001***	0.61	0.14	.	.
Resting systolic BP	0.47	0.06	0.87	0.11	0.39
Resting diastolic BP	0.09	0.58	**0.03***	0.1	0.39
After-exercise systolic BP	0.37	0.23	0.8	0.49	0.39
After-exercise diastolic BP (mmHg)	**0.006***	0.13	0.31	0.14	0.39
Resting HR (bmp)	0.96	0.24	0.83	0.39	0.39
After-exercise HR (bmp)	0.27	0.12	0.91	0.39	0.39
Total distance in 6MW (m)	0.05	0.07	0.21	0.39	0.39

ACEI: angiotensin-converting enzyme inhibitor, ARB: angiotensin receptor blocker, Beta-B: beta blockers, Ca: calcium, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, *: significant differences ($p<0.05$)

In the obesity group, only women showed significant ($p \le 0.04$) changes along the program (Table 35). Weight, BMI and WHR changed significantly.

Table 35. Changes in physical measures along the program in the obesity group in women and in men (Friedman´s ANOVA). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	36	83.03±13.64	81.98±14.07	81.59±14.11	81.59±14.64	8.48	**0.04**
BMI (kg/m^2)	36	34.16±4.37	33.71±4.52	33.56±4.52	33.55±4.75	8.48	**0.04**
Waist circumference (cm)	13	101.30±8.74	99.31±10.31	99.46±9.69	99.46±9.62	2.59	0.46
Waist-hip ratio	12	0.89±0.03	0.88±0.02	0.88±0.01	0.88±0.02	8.89	**0.03**
Flexibility (cm)	2	19.25±4.59	23.13±3.00	18.00±4.24	21.50±2.12	6.00	0.11
Resting systolic BP (mmHg)	.	.	.	.	.		.
Resting diastolic BP (mmHg)	.	.	.	.	.	.	.
After-exercise systolic BP (mmHg)	.	.	.	.	.		.
After-exercise diastolic BP (mmHg)	.	.	.	.	.		.
Resting HR (bpm)	16	80±13.67	83±13.57	82±11.75	83±14.44	3.00	0.39
After-exercise HR (bpm)	16	109±20.39	106±20.28	105±19.79	103±18.90	5.22	0.16
Total distance in 6MW (m)	15	493.93±53.19	507.06±52.87	509.40±53.21	520.26±59.08	6.10	0.11
Men	n	Baseline	3 month	6 month	9 month	X^2_F	p
Weight (kg)	3	92.26±12.27	90.90±12.05	90.30±13.84	90.06±13.23	5.80	0.12
BMI (kg/m^2)	3	31.25±3.98	30.77±3.77	30.57±4.41	30.50±4.29	5.80	0.12
Waist circumference (cm)	1	102	102	101	101	.	.
Waist-hip ratio	1	0.99	0.99	0.98	0.98	.	.
Flexibility (cm)	.	.	.	.	.	.	.
Resting systolic BP (mmHg)	.	.	.	.	.	.	.
Resting diastolic BP (mmHg)	.	.	.	.	.	.	.
After-exercise systolic BP (mmHg)	.	.	.	.	.	.	.
After-exercise diastolic BP (mmHg)	.	.	.	.	.	.	.
Resting HR (bpm)	2	64±6.36	78±2.82	73±7.07	70±2.12	5.40	0.15
After-exercise HR (bpm)	2	89±1.41	97±0.70	81±5.65	97±0.70	5.40	0.15
Total distance in 6MW (m)	2	535±32.52	584±79.19	560±103.23	565±32.52	3.00	0.39

n: number of individuals, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute, X^2_F: Friedman´s ANOVA, p: significance value

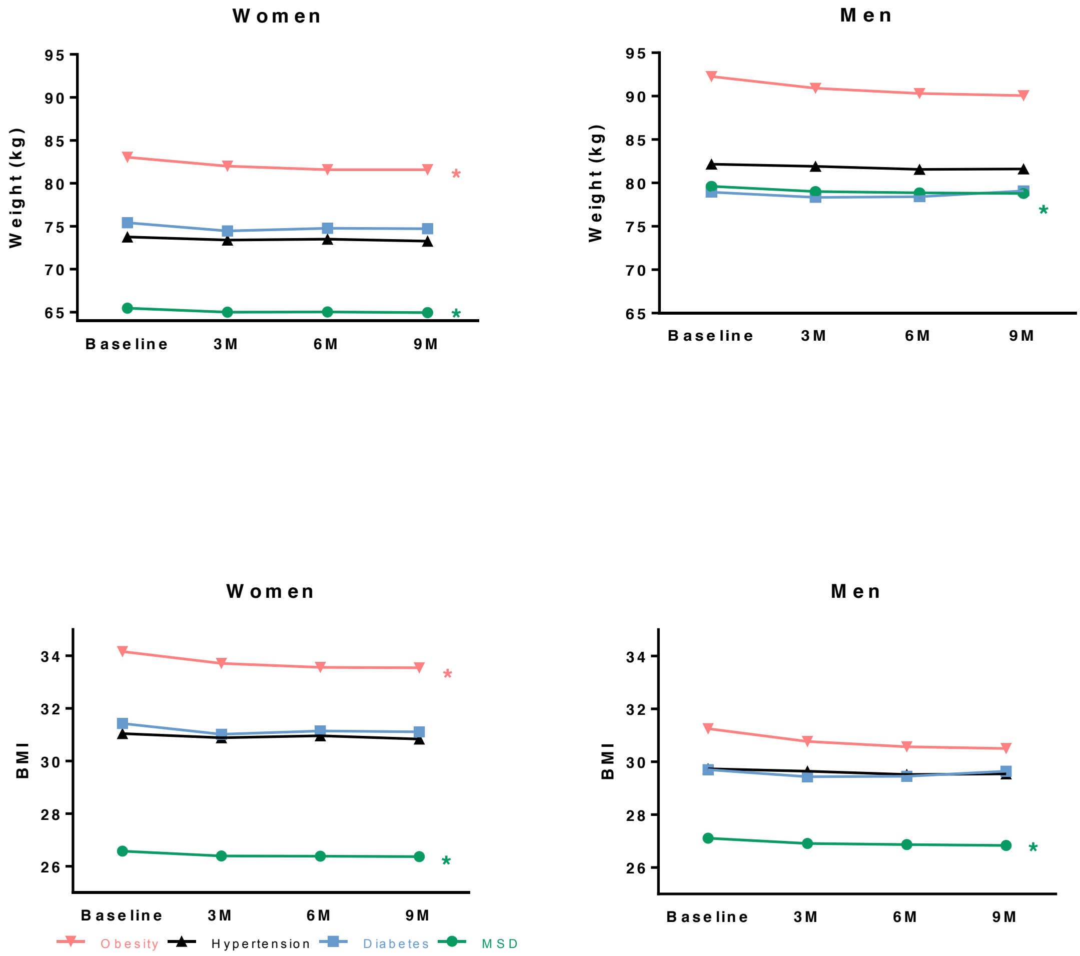
Follow-up tests showed that, similar to other diagnose groups, changes in weight and BMI were significant (p≤0.04) between baseline and all measurements but the effect sizes of these changes were small (d<0.10) (Table 36). Changes in WHR showed to be significant only at nine months (0.90±0.04- 0.88±0.03, d=0.56, p=0.04) and changes in flexibility only at three months (13.56±8.99- 15.88±8.38cm, d=-0.27, p<0.001). Total distance also significantly (p≤0.03) increased at three months and at nine months (Table 36).

Table 36. Changes in physical measures between baseline and 3, 6 and 9 months in the obesity group in women (Wilcoxon´s signed rank test). Values are shown in mean values ± standard deviation.

Women	n	Baseline	3 month	p	d
Weight (kg)	91	82.50±12.74	81.59±12.71	**<0.001**	0.07
BMI (kg/m²)	87	33.51±4.68	33.15±4.67	**<0.001**	0.07
Waist circumference (cm)	24	99.50±9.99	98.33±10.42	0.12	0.11
Waist-hip ratio	24	0.88±0.05	0.87±0.04	0.31	0.22
Flexibility (cm)	31	13.56±8.99	15.88±8.38	**<0.001**	-0.27
Total distance in 6MW (m)	28	495.43±55.34	511.82±52.50	**0.01**	-0.30
	n	Baseline	6 month	p	d
Weight (kg)	68	84.27±12.36	82.99±12.55	**<0.001**	0.10
BMI (kg/m²)	68	34.05±4.29	33.52±4.25	**<0.001**	0.12
Waist circumference (cm)	22	101.27±8.02	100.13±8.29	0.17	0.14
Waist-hip ratio	21	0.88±0.04	0.88±0.03	0.41	0.00
Flexibility (cm)	12	12.42±7.81	14.50±5.57	0.19	-0.31
Total distance in 6MW (m)	25	480.88±67.04	489.48±53.71	0.33	-0.14
	n	Baseline	9 month	p	d
Weight (kg)	48	84.47±13.21	83.21±13.73	**0.04**	0.09
BMI (kg/m²)	48	34.33±4.43	33.79±4.44	**0.03**	0.12
Waist circumference (cm)	21	101.47±8.15	99.61±9.10	0.21	0.21
Waist-hip ratio	19	0.90±0.04	0.88±0.03	**0.04**	0.56
Flexibility (cm)	7	15.93±4.99	17.00±3.65	0.44	-0.24
Total distance in 6MW (m)	24	486.25±62.36	507.08±56.61	**0.03**	-0.35

n: number of individuals, BMI: body max index, 6MW: six-minute walk test, p: significance value, d: effect size (Cohen´s d)

Figure 39. Mean changes in weight and BMI in different diagnosis groups in women and men (Friedman´s ANOVA). Standard deviations are shown in Tables 27, 29, 31 and 35.



M: month, *significant changes (p<0.05) among baseline, 3, 6 and 9 months

Figure 40. Mean changes in waist circumference and flexibility in different diagnosis groups in women and men (Friedman´s ANOVA). Standard deviations are shown in Tables 27, 31 and 35.

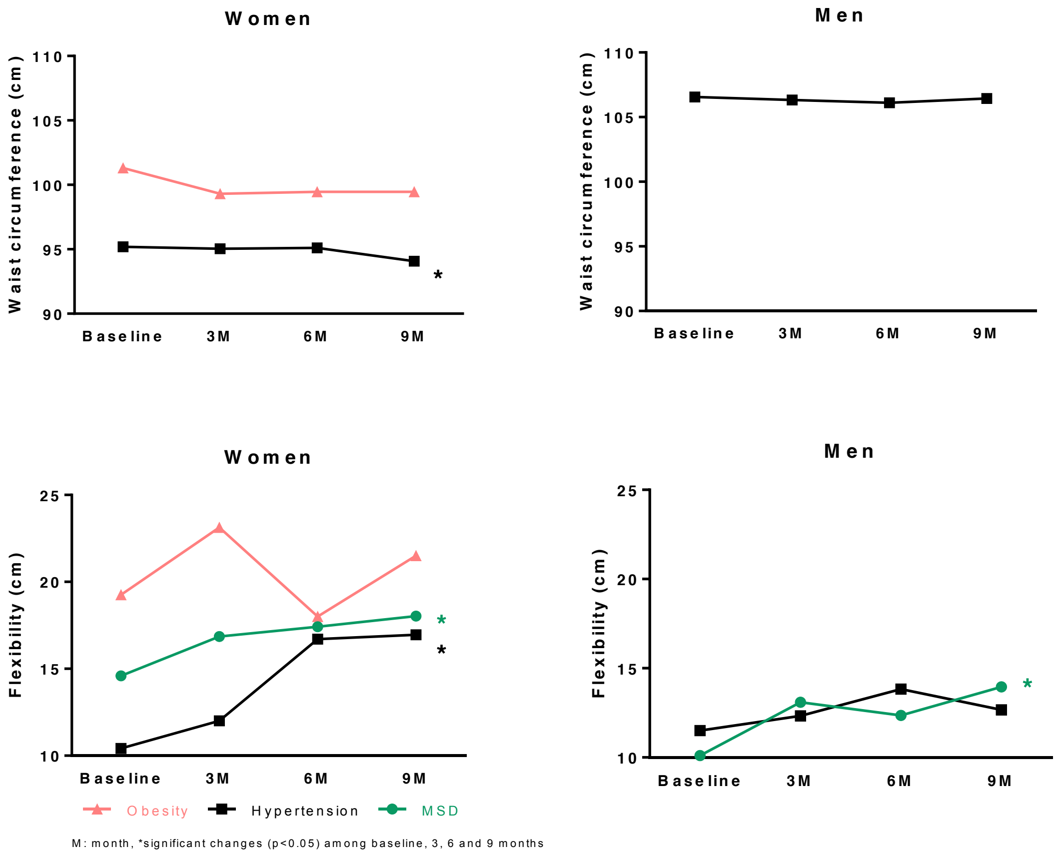


Figure 41. Mean changes in resting blood pressure measures in different diagnosis groups in women and men (Friedman´s ANOVA). Standard deviations are shown in Table 31.

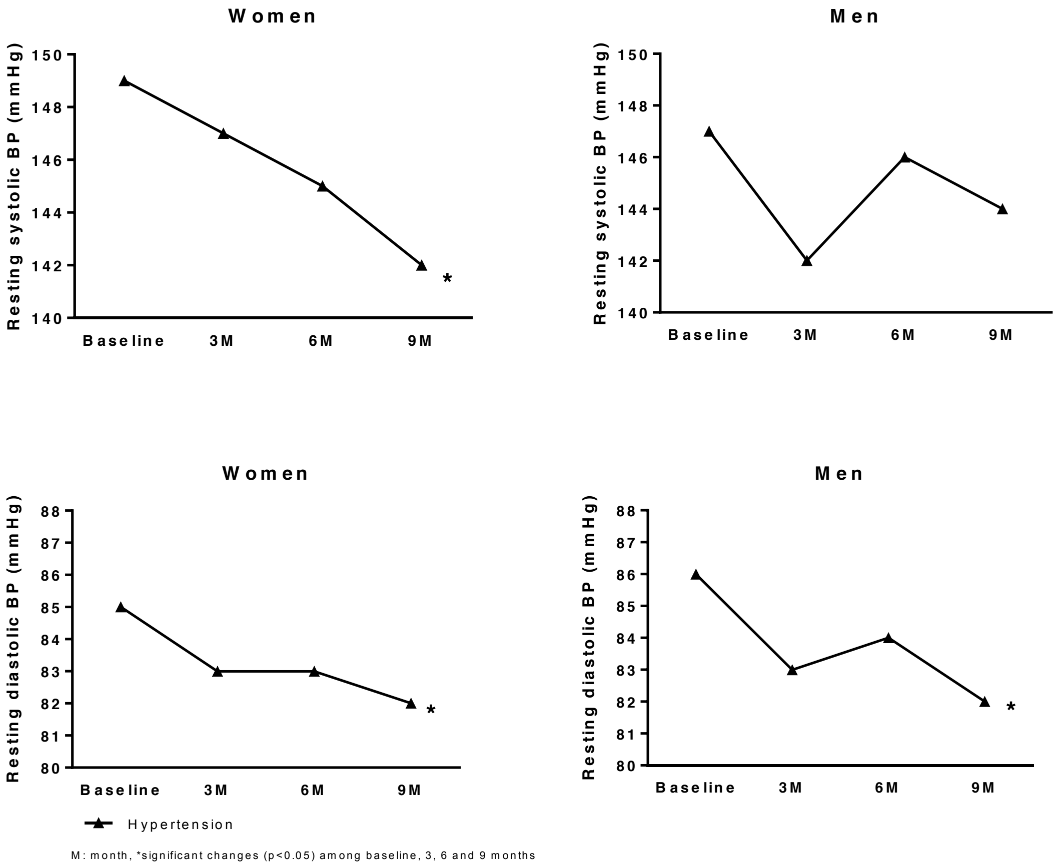


Figure 42. Mean changes in after exercise blood pressure measures in different diagnosis groups in women and men (Friedman´s ANOVA). Standard deviations are shown in Table 31.

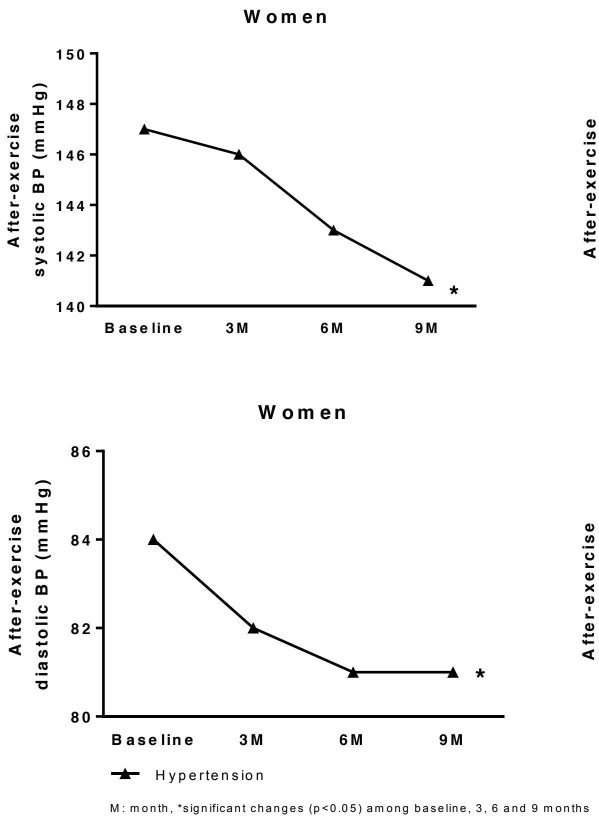
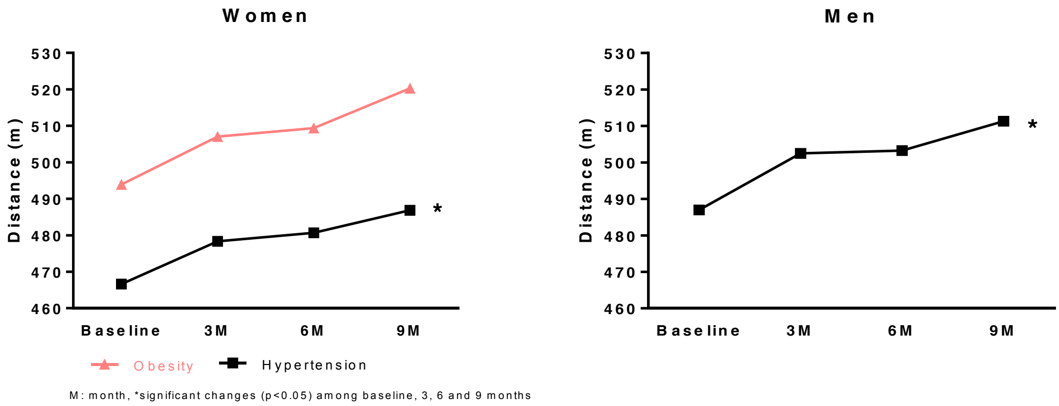


Figure 43. Mean changes in total distance in different diagnosis groups in women and men (Friedman´s ANOVA). Standard deviations are shown in Tables 31 and 35.



4.5. Association between changes in physical measures

Percent changes after nine months are shown in Table 37. The greatest changes were observed in flexibility (64%), followed by total distance (5.6%), all the blood pressure measures (from -2.77% to -3.27%) and the smallest changes in weight, BMI, waist circumference and WHR (from -0.56% to -0.61%).

Table 37. Percent changes in physical measures from baseline to 9 months. Values are shown in percentages (%).

	n	Mean	SD
Weight (kg)	915	-0.56%	3.69
BMI (kg/m²)	867	-0.58%	3.67
Waist circumference (cm)	76	-0.61%	3.71
Waist-hip ratio	76	-0.56%	3.57
Flexibility (cm)	353	63.77%	280.98
Resting systolic BP (mmHg)	202	-2.88%	9.84
Resting diastolic BP (mmHg)	202	-2.87%	10.77
After-exercise systolic BP (mmHg)	184	-2.77%	9.08
After-exercise diastolic BP (mmHg)	184	-3.27%	10.59
Resting HR (bpm)	118	-0.38%	14.24
After- exercise HR (bpm)	49	2.11%	32.97
Total distance in 6MW (m)	114	5.57%	10.64

n: number of individuals, SD: standard deviation, BMI: body max index, BP: blood pressure, HR: heart rate, 6MW: six-minute walk test, mmHg: millimeter of mercury, bpm: beats per minute

Bivariate correlations between percent changes in physical measures were analyzed and changes in weight after nine months were found to be significantly correlated with changes in resting systolic blood pressure (r_s =0.20 [0.05, 0.35], p=0.012) and in resting diastolic blood pressure (r_s =0.17 [0.01, 0.34], p=0.031). Changes in waist circumference were also found to be associated with changes in weight (r_s =0.50 [0.24, 0.69], p<0.001) and changes BMI (r_s =0.50 [0.26, 0.71], p<0.001).

Significant relationships between changes in resting and after-exercise systolic and diastolic blood pressure are showed in Table 38. The strongest relationships were found between changes in resting systolic and diastolic blood pressure (r_s=0.57) and between changes in after-exercise systolic and diastolic blood pressure (r_s=0.62)

Table 38. Spearman´s correlations between resting and after-exercise systolic and diastolic blood pressure.

	Resting systolic BP	Resting diastolic BP	After-exercise systolic BP	After-exercise diastolic BP
Resting systolic BP	1	0.57***[0.452,0.663]	0.54*** [0.412, 0.639]	0.31***[0.164, 0.441]
Resting diastolic BP		1	0.43***[0.296, 0.537]	0.49***[0.364, 0.599]
After-exercise systolic BP			1	0.62***[0.511, 0.709]
After-exercise diastolic BP				1

*p< 0.05, **p< 0.01, ***p<0.001. Bias corrected bootstrap 95% CIs reported in brackets

Changes in after-exercise systolic blood pressure were also found to be associated with changes in resting heart rate (r_s =0.34 [0.103, 0.544], p=0.005). Changes in after-exercise heart rate were significantly correlated with changes in WHR (r_s =0.95 [0.620, 1.00], p<0.001).

Correlation between adherence and changes in physical measures were also examined and average attendance was found to be significantly related to changes in weight (r_s =-0.084 [-0.145, -0.018], p=0.012). However, number of days attended was not correlated with changes in any physical measure.

Similarly, significant differences (H(4)=15.77, p=0.003) in changes in weight were found between participants who attended nine months with the summer break in the middle (-0.06%±3.64) and the ones that attended nine months straight, without the summer in the middle (-0.87%±3.20). Changes in resting and after-exercise systolic blood pressure were also found to be significantly lower (H(4)=11.12, p=0.03) and (H(4)=14.77, p=0.01) in the participants that attended nine months with the summer break in between (-1.73%±10.86 and -1.05%±8.85 respectively) if compared to the ones that attended nine months straight (-5.97%±8.19 and -6.41%±8.79 respectively). Moreover, participants that attended six months with the summer break in between increased their after-exercise systolic blood pressure (2.45%±9.2) unlike the rest of the groups where all of them reduced their after-exercise systolic blood pressure.

4.6. Motivation and satisfaction

Motivation and satisfaction questionnaires showed high scores with a mean of 7.63 points out of 8 in the motivation questionnaire and a mean of 6.56 points out of 7 in the satisfaction questionnaire.

On the motivation questionnaire, after nine months, 93.8% of participants reported enjoying doing exercise. Regarding their general opinion about the program, 99.8% found their partners nice and pleasant, 99.6% also found the instructors nice and kind and 84.1% were satisfied with the sports facilities. Concerning their self-confidence, 95% believed that they were able to improve their physical condition and 93.6% had support from family and/or friends. 97.4% of participants reported being motivated to assist to the program and 99.6% believed that the program was going to benefit their health.

There were no significant differences in the motivation questionnaire between women and men except in sports facility satisfaction, were significantly less women (81.8%) than men (91.1%) reported being satisfied with the facilities ($x^2(1)=6.098$, $p=0.014$). No significant differences were found among age groups. Interestingly, among diagnosis groups, significantly more individuals (25%) from the diabetes group showed low self-confidence if compared to the other diagnosis groups, as they did not believe that they were able to improve their physical condition.

On the satisfaction questionnaire, after finalizing the nine month program, 97.7% of the participants reported that they were feeling better with themselves since starting exercising. 91.4% also felt that they were more capable to perform everyday chores since the program started. In addition, 96.5% considered that they had achieved small improvements that would make them feel better and control their condition adequately. These achievements were larger than what they expected in 73.5% of the participants. Regarding safety and controls, 97.7% considered appropriate the follow-ups and controls performed by health professionals and 99.6% thought the same about the physical activity professionals. Moreover, 100% of the participants were satisfied with the individual attention received.

No significant differences were found in the satisfaction questionnaire between women and men or among age groups. However, significant differences were found among diagnosis groups, were more individuals in the diabetes group (31%) reported low functionality if compared to the other diagnose groups, as they felt that they were not more capable to perform every day chores since the program started.

DISCUSSION

5. DISCUSSION

The primary objective of this study was to evaluate the effectiveness of a therapeutic exercise program designed for individuals suffering from diverse chronic conditions including musculoskeletal disorders, diabetes, hypertension and obesity. For this purpose different physical variables were measured such as weight, BMI, waist circumference, waist-hip ratio, flexibility, blood pressure, heart rate and cardiorespiratory fitness. This investigation also assessed the baseline characteristics of the participants in order to describe the population being studied. Finally, an evaluation of the exercise program was performed in order to discern strengths and areas of improvement in order to steer prospective programs.

5.1. Characteristics of the sample and baseline physical measures

According to recent surveys, more than half of the Basque population is overweight (BMI >25 kg/m^2) and this proportion is larger in men (62%) than in women (42%) (INE, 2012). In our study, mean BMI was 27 kg/m^2 and the proportion of overweight individuals was higher (69%) than the one described for the Basque population, somehow expected as the individuals included in this program were selected according to their risk factors, one of the inclusion criteria being having a BMI over 25 kg/m^2. We also observed slightly more men being overweight if compared to women (74% vs. 68%). The tendency of BMI to increase with age and decrease in the oldest individuals over 75 years of age observed in the Basque population (Gobierno Vasco, 2013b) was equally detected in our study. Interestingly, the percentage of overweight individuals was not only elevated in the obesity group but also in the rest of the groups.

Concerning waist circumference, in our sample only 11% of the participants had an optimal waist circumference with the rest having a waist circumference that could contribute to an increased risk of metabolic complications and CVD. Both women (78%) and men (56%), all age groups (84-91%) and all diagnosis groups (80-100%) showed a great number of individuals with increased waist circumference. This seems of great importance as waist circumference has been shown to have a direct independent association with mortality in the older population, especially in the ones with poor health status (Guallar-Castillón et al., 2009).

An increased appearance of mechanical disorders such as osteoarthritis, cervical and low back pain have been observed in overweight individuals, mainly explained by a greater mechanical loading at the joints but also related to other hormonal and systemic factors associated with obesity which cause changes in cartilage and bone metabolism (Padros-Torres et al., 2012; Stevens-Lapsely and Kohrt, 2010). Accordingly, in our sample a great proportion of obese individuals (77%) suffered some sort of musculoskeletal disorder, 19% of these suffering from osteoarthritis. The high percentage of overweight individuals in the diabetes and hypertension groups and the mechanical-obesity multimorbidity pattern just mentioned could also explain the high incidence of MSD in these two groups.

Another multimorbidity cluster was also observed where a quarter of the diabetic individuals suffered from hypertension and 13% were obese. Similarly, among the hypertension group, 4% of the individuals were diabetic and 9% obese. This cardio-metabolic multimorbidity pattern also known as “metabolic syndrome” has previously been described by others (Padros-Torres et al., 2012; Schafer et al., 2010). It includes diabetes, hypertension, obesity and dyslipidaemia and its evolution over time leads to CV complications related to these disorders (Padros-Torres et al., 2012).

Similar to our results, the prevalence of different chronic conditions and multimorbidity patterns have also been described to increase with age (Gobierno Vasco, 2013b; Padros-Torres et al., 2012; Schafer et al., 2010). In particular, 24% of the Basque population suffers from multiple chronic conditions while this proportion rises to 66% in the population over 65 years of age and to 76% in the population 80-84 years of age (Orueta et al., 2014).

In agreement with the development of diabetes and hypertension observed in the Basque population (Gobierno Vasco, 2013a) and described by others (Padros-Torres et al., 2012), the onset of diabetes and hypertension in our sample was also observed to start in the 41-50 age group and increase after that. Consequently, the most prevalent disorders among the youngest groups in our study were those related with the musculoskeletal system. Fibromyalgia and osteoporosis were also observed to have a greater prevalence in women if compared to men, consistent with the trends observed in the Basque Country (Gobierno Vasco, 2013a) and worldwide (Busch et al., 2011).

Regarding blood pressure, among the hypertensive participants a great percentage of individuals (77%) were found to have non-controlled blood pressure, possibly explained by the fact that only 65% were under hypertensive medication. Nevertheless, as it has been described by others (Coca Payeras, 2005), only 40% of the hypertensive patients using medication have a controlled blood pressure, influenced by factors such as lack of modification of ineffective treatment or insufficient patient compliance among others.

Confirming the efficacy of the medication, individuals under medication had lower blood pressure values if compared to the non-medicated individuals. The well documented lowering effect of beta-blockers on heart rate (ACSM, 2014; Kokkinos et al., 2006) was also observed in our hypertensive participants, with the patients under this medication having lower levels in both resting and after-exercise heart rate if compared to other drug therapies.

No differences in blood pressure were found between women and men. However, in agreement with the trends observed in the Basque population (Gobierno Vasco, 2013b), an increasing tendency with age was observed in resting and after-exercise systolic blood pressure.

After-exercise values of both systolic and diastolic blood pressure were found to be slightly lower than the resting ones (≈1-2 mmHg). This immediate reduction of blood pressure after an acute bout of exercise, named post-exercise hypotension, occurs in most individuals, normotensive and hypertensive (Pescatello et al., 2004), sedentary (Cornelissen et al., 2010) and active older individuals (Brito et al., 2014). These small reductions are clinically relevant and highly significant in terms of public health, as they can decrease the risk of stroke by 16% and the risk of coronary artery disease by 8% with an isolated exercise bout (Pescatello et al., 2004).

Concerning heart rate, even though mean resting heart rate in our sample was found to be slightly lower (76 bmp) than the threshold of 80 bmp that has been suggested to lead to an increased mortality risk (Palatini et al., 2002), subgroups analysis revealed levels close and above this threshold. In particular, 77 bmp in women, 84 bmp in women 41-50 years old, 78 and 79 bmp in obese women and men respectively, 81 bmp in women with MSD and 85 bmp in diabetic women, which could have important clinical implications. As observed by others (Antelmi et al., 2004; Palatini et al., 2002), in our sample resting and after-exercise heart rate were higher in women and showed a trend to decrease as age increased. Interestingly, women in the diabetes group had the highest heart rate if compared to the other groups. This association between elevated heart rate and diabetes it is believed to be caused by a low cardiorespiratory fitness (Carnethon et al., 2008) or by an impaired autonomic nervous system function where sympathetic over-activity increases heart rate and also blood glucose (Li et al., 2014; Grantham et al., 2013). Thus, apart from being a serious complication of type 2 diabetes (Vinik and Ziegler, 2007), it seems that elevated heart rate could also be an important marker in the diagnosis of diabetes (Carnethon et al., 2008), CVD (Fox et al., 2007) and mortality (Cooney et al., 2010).

In terms of hamstring flexibility and consistent with the literature (Gopi, Neeta and Megha, 2014; Sugimoto, Demura and Nagasawa, 2014), women were found to be more flexible than men and a decreasing trend in flexibility as age increased was also observed.

Confirming other studies (Sugimoto, Demura and Nagasawa, 2014; Casanova et al., 2011), gender and age were also found to be important factors influencing the score in the 6MW, with greater scores observed in male and younger individuals. Mean scores in both women and men were found to be lower than other reference values reported in healthy individuals for the same age group (Sugimoto, Demura and Nagasawa, 2014; Casanova et al., 2011). Moreover, these values were on the 10th percentile in women and in the 5th percentile in men, which shows a below-average and poor cardiovascular fitness in our sample (Rikli and Jones, 2013). In comparison to individuals with chronic conditions, our sample still showed lower values (473 m) than the ones observed in obese participants (535 m) (Ekman et al., 2013), in women with fibromyalgia (519 m) (Sanudo et al., 2011) and similar to the ones in found in diabetic patients (476 m) (Tuttle et al., 2011).

5.2. Participation, adherence and motivation

It seems important to investigate the factors that influence exercise participation, as 21% of the patients that attended the consultation with the sports doctor decided not to start the program. Grandes et al. (2008) observed that a great proportion of the sedentary subjects attending a primary care consultation were not ready to change their behavior towards physical activity and therefore were not appropriate candidates to start a physical activity intervention.

The pronounced difference in participation between women (77%) and men (33%) also deserves some attention. Considering that the recruitment was performed through primary care, it could be expected that the number of women visiting the family doctor would also be greater and thus the larger proportion of women referred to the program. However, even though the number of Basque women visiting their family doctor has been observed to be higher than in men (80% vs. 74%) (Esnaola et al., 2013), this difference is not as prominent as the one observed in our study.

As some authors have suggested (Molanorouzi, Khoo and Morris, 2015), health reasons is believed to be the strongest factor in adult women for physical activity participation which could explain their greater willingness to participate in the program. On the other hand, mastery and competition have been suggested to be the strongest intrinsic motivators in men (Molanorouzi, Khoo and Morris, 2015).

Increasing age has also been observed to raise the number of individuals visiting their family doctor (Esnaola et al., 2013), hence, the greater proportion of participants (70%) above 50 years of age in our study. Also, a greater concern for health outcomes in older individuals if compared to younger individuals (Trujillo, Brougham and Walsh, 2004) could clarify this participation disparity among age groups. Nevertheless, among the older individuals in our study (51-80 years of age) a descending participation trend was observed with the highest participation rates observed in the 51-60 age group (33%) and the lowest in the 71-80 age group (10%). A higher motivational readiness to change observed at younger age (Grandes et al., 2008) could explain this decline in participation in the oldest groups.

Regarding diagnose, the prevalence of disorders diagnosed in primary care in a recent survey (INE, 2014) are also in agreement with the proportion of participants suffering from these disorders in our study. In more detail, 54% of the disorders diagnosed in the general population were MSD (INE, 2014). This proportion was greater in women (70%) and interestingly, it was identical to the participation rate observed in our sample possibly influenced by the significantly greater number of women in our study.

Interestingly, Grandes et al. (2008) also observed that obese and hypertensive individuals had a greater probability of being motivated to change their physical activity behavior. However, in subjects who combined both risk factors the motivational readiness to change was inexistent (Grandes et al., 2008).

In accordance with these observations, physical limitations or disorders have been suggested to be both, a primary barrier but also a key motivator for exercise participation (Ceria- Ulep, Serafica and Tse, 2011; Belza et al., 2004).

Similarly, poor perceived health (Plotnikoff et al., 2004) and pain have been associated with early dropout (Tu et al., 2004) and also, a negative association between different chronic conditions (Morey et al., 2003), BMI and physical activity levels (Jancey et al., 2007) has been described in relation to exercise adherence. All these factors could explain the fact that less than half of the participants completed the full program and possibly also the lower adherence in our participants if compared to other interventions (Skrypnik et al., 2015; Davidson et al., 2009; Sigal et al., 2006). Nevertheless, other authors have reported similar adherence rates to the ones observed in our intervention in overweight (Stefanov et al., 2013) and dyslipidemic individuals (Bateman et al., 2011) after combined exercise.

In addition to health problems, lack of time due to family care (Garmendia et al., 2013; Ceria- Ulep, Serafica and Tse, 2011) and self-efficacy (Koeneman et al., 2011; Perkins et al., 2008) have also been suggested to be main barriers to adherence and participation in physical and social activities in older adults.

However, considering that a very high proportion of the participants reported feeling capable of improving their physical condition and also expressed being motivated to assist to the program, self-efficacy does not appear to be the main barrier to exercise in our sample. Nevertheless, it is important to note that the diabetic participants in our intervention reported a lower self-confidence and a lower perceived functionality if compared to other participants, which could suggest the need of motivational interventions targeted to this population.

"Personal reasons" was found to be the major attrition cause in our participants. Nonetheless, it does not elucidate the exact reasons for dropping out and consequently hampers the possibility of finding resources to improve adherence in future programs.

Also, even though older age has been proposed as a factor negatively affecting physical activity participation (Bauman et al., 2012), in our study conflicting results were found with comparable or even slightly higher adherence rates recorded in the older groups. Similarly, several authors did not find associations between age and attrition (Koeneman et al., 2011; Jancey et al., 2007) suggesting that the relationship between adherence and age might be confounded by physical health (Morey et al., 2003).

The number of injury consultations also deserves some attention as even though the average number of consultations was similar to the injury rates reported by other authors (Stathokostas et al., 2013), some years showed greater rates close to 50%. Nonetheless, these results need to be interpreted with caution as it is plausible that the consultations could have been related to exacerbated existing conditions. These remarks certainly raise the issue of the risks associated with exercise. However, wide evidence supports the fact that the benefits obtained with physical activity offset the risks (ACSM, 2014).

Interestingly, greater changes were observed in weight and in systolic blood pressure in the participants that attended nine months straight if compared to the ones that had the summer break in between, possibly explained by a detraining effect occurred during the summer. Supporting this fact, Tokmakidis, Spassis and Volaklis (2008) observed a total loss of the positive training-induced changes in body composition, strength and a decreasing tendency in aerobic capacity after four months of detraining. Carvalho, Marques and Mota (2009) also observed a significant decline in functional performance in older women after three months of detraining. Similarly, strength and flexibility have been observed to decrease after three months of detraining (Fatouros et al., 2006).

However, according to this author, the strength a flexibility levels were preserved above baseline levels for a longer period after moderate and high intensity resistance exercise if compared to low intensity resistance exercise (Fatouros et al., 2006). In agreement, Harris et al. (2007) also reported that despite significant strength losses during 20 weeks of detraining, these values were still greater than pre-training values. On the other hand, Henwood and Taaffe (2008) observed significant decreases in strength and power but not in functional ability after 12 weeks of detraining, suggesting that exercise performed at an appropriate intensity might preserve functional decline.

Hence, these findings highlight the importance of incorporating exercise or physical activity in our daily living and throughout the life (Tokmakidis, Spassis and Volaklis, 2008) and also the use of sufficient intensities to ensure maintenance of appropriate physical fitness levels specially in the individuals that may see their exercise practice discontinued due to health problems or other issues (Fatouros et al., 2006). In addittion, these findings emphasize the importance of developing programs that support confidence building and assist in overcoming barriers to participation (Perkins et al., 2008). In this way, an increase in participation and adherence may possibly guarantee the effectiveness of community based interventions (Garmendia et al., 2013).

5.3. Changes in physical measures

5.3.1. Body composition

In a recent extensive review of physical activity interventions and their relationship with body composition (Weber et al., 2013), the mean effect for body composition outcomes was estimated in $d=-0.16$ and this effect was found to be greater in studies that included a structured exercise intervention ($d=-0.48$). In contrast, very small effect sizes ($d<-0.03$) were found in our intervention in all body composition outcomes (weight, BMI, waist circumference and WHR).

Some authors have suggested that even though moderate physical activity alone might be appropriate for weight control or maintenance of weight loss (Jakicic and Otto, 2005; Slentz et al., 2004), its effectiveness in weight loss is weak (Sweet and Fortier, 2010). In terms of body weight, it is important to consider both energy expenditure and energy intake when assessing weight loss after physical activity, as increases in energy expenditure might be compensated by increases in energy intake (Church et al., 2009). In accordance, many studies have previously suggested that in order to achieve weight loss both physical activity and dietary behavior should be targeted (Foster-Schubert et al., 2012; Sweet and Fortier, 2010). Conversely, the review by Weber et al. (2013) reported no differences in body composition changes between interventions of physical activity with and without diet. This could suggest that participants of a physical activity intervention might be motivated to change their dietary habits on their own, which emphasizes the importance of controlling dietary changes when assessing weight loss after physical activity.

Despite these remarks, several combined exercise interventions that controlled for changes in calorie intake have reported important reductions in body weight only attributable to physical activity, ranging from 2.71 kg to 1.5 kg (Skrypnik et al., 2015; Paoli et al., 2013; Willis et al., 2012; Bateman et al., 2011; Church et al., 2010; Davidson et al., 2009; Sigal et al., 2007). The modest reductions observed in our sample (0.5 kg) could be possibly explained by insufficient exercise stimulus, poor adherence, uncontrolled dietary intake or a combination of these factors. Also, an increase in lean mass induced by resistance exercise could explain the lack of weight loss (Church et al., 2010).

Furthermore, inter-individual variation in weight loss seems to be a fundamental factor to be considered, as the analysis of the group mean weight loss could lead to incorrect conclusions since it does not account for individual metabolic and behavioural compensatory mechanisms such as increased energy intake or changes in non-exercise activity among others (King et al., 2008). For instance, while the mean percent change in weight in our sample was -0.56%, the standard deviation of 3.69% illustrates a great variability among participants. This variability could translate into an average weight loss of 2 kg, comparable to the decreases observed in similar combined exercise interventions.

Regarding waist circumference, modest reductions of approximately 1 cm were observed in our participants after nine months. In comparison with other interventions of similar design, which combined aerobic and resistance exercise performed three days a week, the reductions observed in our study were minor, as others observed reductions that ranged from 4 cm to 7.65 cm (Skrypnik et al., 2015; Bateman et al., 2011; Davidson et al., 2009; Sigal et al., 2007). Interestingly, the greatest waist circumference reductions in these interventions were observed in individuals with the highest BMI which could suggest that the lower BMI of our participants hindered greater reductions in waist circumference. Supporting this notion, Freak-Poli et al. (2011) observed associations between a greater waist circumference at baseline and greater reductions after the intervention. In agreement with these observations, McTiernan et al. (2007) also described that overweight or obese individuals lose more weight than individuals of normal weight. Nevertheless, a 1 cm increase in waist circumference has been related with a 2% increase in risk of developing CVD (De Koning et al., 2007) which implies that our modest reductions could be clinically relevant.

The reductions observed in our sample were significantly greater in women (1.5 cm) than in men (0.10 cm) which is in contrast with other reports. For instance, after a 12 month moderate-vigorous aerobic training performed six days a week, the mean reduction in waist circumference in women was 1.4 cm and 3.3 cm in men (McTiernan et al., 2007). Similarly, greater reductions of total and visceral fat were found in men if compared with women after aerobic exercise performed five days a week (Davidson et al., 2009). On the other hand, Freak-Poli et al. (2011) observed similar waist circumference reductions (1.6 cm) in both women and men after a four month workplace program. As previously mentioned, it could be presumed that the greater changes in the female participants in our program could be due to their greater baseline waist circumference (Freak-Poli et al., 2011), despite both women and men had an elevated baseline waist circumference, 17 cm and 13 cm above optimal levels respectively, considered high risk for metabolic complications and CVD (WHO, 2008).

As already mentioned in the introduction, abdominal fat has been suggested to be a better predictor of the incidence of type 2 diabetes and CVD than the total amount of fat (Ibañez et al., 2010; Fencki et al., 2006) and has a direct association with mortality in older adults independent of BMI (Guallar-Castillón et al., 2009). This supports the use of waist circumference or WHR besides BMI in CVD risk assessments (Pischon et al., 2008; De Koning et al., 2007).

Interestingly, some authors have observed significant decreases in waist circumference (Church et al., 2009) and improvements in cardiovascular risk (Cox et al., 2001) independent of changes in body weight. Similarly, important risk factors associated with obesity such as cardiorespiratory fitness and insulin sensitivity have shown improvements despite minimal or no weight loss (Fogelhom, Stallknecht and Van Baak, 2006; Jakicic and Otto, 2005), which emphasizes the health benefits of physical activity regardless of weight loss. In spite of this, it seems important to identify individual needs as in some circumstances weight loss could be essential in the improvement of musculoskeletal disorders such as symptoms of knee-osteoarthritis among obese individuals (Stevens-Lapsley, 2010).

5.3.2. Blood pressure and heart rate

After our nine month intervention, small to medium effect sizes were observed in blood pressure measures (systolic and diastolic) with reductions of around 5 mmHg. These findings are in agreement with other reports which described reductions of 3-8 mmHg in systolic blood pressure and 2-6 mmHg in diastolic blood pressure (Wilmore, 2001). On the other hand, other reviews have claimed slightly greater reductions that ranged between 5 mmHg and 10.5 mmHg in systolic blood pressure and between 0 and 10 mmHg in diastolic blood pressure (Semllitsch et al., 2013). Similarly, Paoli et al. (2013) and Skrypnik et al. (2015) observed greater reductions of 9-11 mmHg in systolic blood pressure but comparable decreases to our findings in diastolic blood pressure (2-4 mmHg), after a combined exercise intervention. In contrast, Cornelissen and Smart (2013) reported reductions only in diastolic blood pressure (2.2 mmHg) but not in systolic blood pressure after combined exercise training.

Surprisingly, the aforementioned greater reductions in systolic blood pressure (9-11 mmHg) were described only after three months of intervention (Skrypnik et al., 2015; Paoli et al., 2013). Moreover, even one month interventions have induced significant reductions in blood pressure among pre- and stage 1 hypertensive subjects (Collier et al., 2008). Accordingly, the reductions observed in our intervention revealed to be as great as 3.3 mmHg in systolic blood pressure and 1.87 mmHg in diastolic blood pressure after only three months.

Nevertheless, it is important to note that the lower reductions observed in our interventions compared to other studies could be explained by differences in baseline blood pressure among participants. In more detail, Cornelissen and Smart (2013) detected greater reductions in hypertensive individuals if compared to pre-hypertensive or normotensive subjects. Similarly, greater changes in blood pressure among unhealthy individuals have also been described if compared with healthier individuals (Wilmore, 2001).

In terms of gender differences, a lower effect of exercise in blood pressure has been suggested in women (Wilmore, 2001) and greater blood pressure reductions have been observed in men after dynamic endurance training (Cornelissen and Smart, 2013). However, in agreement with our results, other studies have not described these differences between genders (Pescatello et al., 2004; Cox et al., 2001). Similar to other reports, in our intervention, age did not seem to interfere with changes in blood pressure either (Manfredini et al., 2009).

As the ACSM (2014) has stated, minor reductions of 2 mmHg have the potential of considerably reducing the risk of stroke and of coronary artery disease in addition to decreasing risk of CV mortality and all-cause mortality (Rossi et al, 2012). Therefore, our findings have relevant implications in the health status of subjects with hypertension. It is also important to remark that reductions in blood pressure could be obtained independent of improvements in cardiorespiratory fitness or body composition (Collier et al., 2008, Cox et al., 2001).

In regard of heart rate, significant reductions were not observed in the total sample after nine months. In contrast, subgroup analyses showed reductions of 3.3 bpm in men, despite not being statistically significant, but not in women. The oldest age group (71-80) also showed statistically no significant resting heart rate reductions of 4.7 bpm. In accordance with our results, aerobic exercise has been observed to induce important reductions in heart rate of 5 bpm after only 10 weeks (Cornelissen et al., 2010) and four weeks (Collier et al., 2008). Skrypnik et al. (2015) also described decreases in heart rate (3.41 bpm) after a three months combined exercise training similar to ours. As Carter, Banister and Blaber (2003) described, endurance exercise induces various changes in the autonomic control of the heart that decrease resting heart rate such as an increase in the parasympathetic activity and a decrease in the sympathetic activity.

Nevertheless, the unusual lack of effect on heart rate in women deserves some consideration. Despite some gender differences in autonomic cardiovascular control, both women and men are believed to benefit from autonomic control changes in the heart after aerobic exercise (Carter, Banister and Blaber, 2003). Deficient exercise intensity could explain this lack of effect on heart rate in women. However, Cornelissen et al. (2010) observed reductions in resting heart rate even after low-intensity aerobic training, despite the effects were greater with high-intensity training. Another plausible explanation is the high variation of heart rate influenced by environmental factors (Palatini et al., 2007), circadian rhythm or posture (Fox et al., 2007), which supports the use of 24-hour recording as a more reliable estimate of usual heart rate if compared to single measurements performed in a clinic setting (Palatini et al., 2007). Nevertheless, these results deserve more attention due to the relationship between elevated heart rate and increase risk in mortality described previously (Cooney et al., 2010; Palatini et al., 2002).

5.3.3. Flexibility

Hamstring flexibility significantly improved after nine months (3.6 cm) showing similar improvements in both women and men, and also among age groups. These increases are in accordance to other interventions (3.3 cm) (Cancela and Ayán, 2007), but slightly lower than others that observed changes of 4.8 cm (Carvalho, Marques and Mota, 2009). Endurance and resistance interventions alone have also been observed to induce similar improvements (2-4 cm) (Sousa et al., 2014; Hallage et al., 2010; Fatouros et al., 2006; Kalapothrarakos et al., 2005).

In addition, despite more modest, the observed improvements were already noticeable at three months as others have described (Hallage et al., 2010). Surprisingly, even shorter interventions of 9-10 weeks have also induced significant improvements in hamstring flexibility (Toraman, Erman and Agyar, 2004; Barbosa et al., 2002).

Interestingly, hypertensive women showed the greatest improvements in hamstring flexibility (6 cm). These results could be explained by a lower baseline levels if compared to other women. In particular, mean flexibility at baseline was lower in the hypertension group, both in women and men if compared to the total sample. In agreement with our observations, Kim et al. (2014) detected improvements in flexibility in sedentary individuals but not in active ones which reveals the necessity of individualized interventions according to personal physical general fitness and function.

Considering the association between flexibility and functional status and the consequent increase in the performance of activities of the daily live such as walking and stair climbing (Fatouros et al., 2006), our improvements appear to be relevant as key contributors to independent living (Ernsth-Bravell, Zarit and Johansson, 2011).

5.3.4. Cardiorespiratory fitness

Improvements of around 23 m (5%) were observed in the 6MW, used to assess cardiorespiratory fitness. These results are comparable to the improvements observed in other combined exercise interventions (4.5-6%) following six (Santana et al., 2012), nine (Sousa et al., 2014) and 12 month programs (Mian et al., 2007). On the other hand, other investigators have reported more pronounced increases of 10.5% (Hallage et al. 2010) and 13.4% (Toraman, Erman and Agyar,2004) after even shorter interventions, three months and nine weeks respectively, possibly explained by a lower baseline physical fitness of the participants. Increases in 6MW distance of 20 m have been related to small meaningful clinical changes and increases of 50 m related to moderate improvements in healthy older adults (Perera et al., 2006). However, others have claimed an increase in 6MW distance of more than 50 m as clinically meaningful in individuals with some sort of disease (Rasekaba et al., 2009).

Interestingly, some authors reported no significant differences in the improvement of 6MW between aerobic training and combined training despite a lower volume of aerobic exercise in the combined training arm (Sousa et al., 2014). It is necessary to consider that the performance on the 6MW test is associated with both aerobic endurance and lower body strength (Rikli and Jones, 2013) which could explain the comparable improvements after combined training and aerobic training. These findings appear to be advantageous considering the added benefits of resistance training on body composition (Stensvold et al., 2010; Park et al., 2003) and functional status, especially in the older population (Bird et al., 2011), apart from the well documented benefits of aerobic exercise (ACSM, 2014).

As other authors have reported (Skrypnik et al., 2015; Hallage et al., 2010; Stensvold et al., 2010; Toraman, Erman and Agyar, 2004), improvements in cardiorespiratory fitness were already apparent at three months, emphasizing the short-term benefits of physical activity.

Interestingly, despite similar changes between women and men, greater changes (8%) were observed in the younger groups (51-60) if compared to the oldest group (71-80), were changes were minor (1.4%) and did not reach statistical significance. In agreement, Woo et al. (2006) observed no differences in exercise response between women and men reporting similar increases in VO_{2max}. Also, these authors detected that the oldest subjects were not able to augment their VO_{2max} to the same extent as the younger subjects, possibly explained by an age-related faster decline rate of VO_{2max} (Woo et al., 2006).

Nevertheless, greater training-induced improvements in the elderly individuals were described if compared to the younger subjects, including greater improvements in exercise efficiency, suggesting that the differences in cardiorespiratory fitness between older and younger populations might be confounded by lower fitness levels and therefore and most importantly, they could be reversed with exercise (Woo et al., 2006).

Furthermore, diabetic women showed the greatest changes (10%), possibly explained by a floor effect, a low baseline cardiorespiratory fitness levels previously mentioned. Nevertheless, hypertensive women had similar baseline values to diabetic women in cardiorespiratory fitness but their improvements were not as pronounced. The acute administration of diuretics and beta-blockers in hypertensive individuals have been suggested to reduce exercise capacity and attenuate the response to training (Ladage, Schwinger and Brixius, 2013; Fagard, Staessen and Amery, 1993). Others have also agreed on the diminished exercise capacity induced by beta-blockers but have not described reductions in the cardiovascular benefits caused by exercise such as enhanced endothelium-dependent vasodilation or blood pressure reduction (Westhoff et al., 2007).

Comparisons between our medicated and non-medicated individuals showed significant cardiorespiratory improvements in the medicated ones but not in the non-medicated ones. Hence, despite hypertensive medication could have hindered the effect of physical activity in cardiorespiratory fitness it could be presumed that other factors might have affected these responses to exercise. An uncontrolled increase in systolic blood pressure during exercise suffered by non-medicated hypertensive individuals (Kokkinos et al., 2006) could have interfered with the achievement of appropriate exercise intensity levels and consequently hampered beneficial cardiorespiratory modifications.

It should be noted that even though the 6MW and cardiorespiratory fitness levels measured as VO_{2max} are highly associated (Rikli and Jones, 2013), the relationship between the changes in distance in the 6MW and changes in VO_{2max} is not clear, suggesting that the 6MW might not be appropriate to detect changes in cardiorespiratory fitness in healthy individuals (Santana et al., 2012). Nevertheless, the 6MW is considered essential in the evaluation of functional exercise and exercise tolerance, as it assesses the performance of different systems related with submaximal exercise such the cardiorespiratory system and muscle metabolism among others (Capodaglio et al., 2012), in addition to reflecting daily activity functioning better than laboratory tests (American Thoracic Society [ATS], 2002).

5.4. Association between changes in physical measures

There is wide evidence that supports the association between weight loss and reductions in blood pressure in normotensive and hypertensive individuals (Winnicki et al., 2006) and also in non-obese and obese subjects (Mandai et al., 2015; Annesi, 2013). In agreement, in our intervention changes in weight were found to be associated with changes in resting blood pressure. Nevertheless, it is important to note that the changes in weight observed in our participants were minimal. Interestingly, Winnicki et al. (2006) described that the association between weight reduction and consequent decline in blood pressure was not linear, meaning that the dose-response association between these two variables was solely noticeable up to 13% of initial weight loss. These results emphasize the fact that blood pressure reductions can be achieved with minimal weight loss. In the same way, and as previously mentioned, important improvements in key risk factors including CV fitness, insulin sensitivity, fat mass and muscle mass have also been observed with minor o no weight loss (Donelly et al., 2009; Ross and Bradshaw, 2009; Fogelhom, Stallknecht and Van Baak, 2006; Jakicic and Otto, 2005).

Strong relationships between systolic and diastolic changes were also found among our sample. In agreement, similar results have been reported by others showing decreases in both systolic and diastolic blood pressure after exercise (Semlitsch et al., 2013). A review by Cornelisen and Smart (2013) also showed reductions in both systolic and diastolic blood pressure after endurance and resistance training but surprisingly combined training only showed to reduce diastolic blood pressure. Despite, most authors have observed more pronounced post-exercise systolic blood pressure reduction if compared to diastolic blood pressure reduction (Semlitsch et al., 2013; Terblance and Millen, 2012), the differences observed in our total sample were minimal. Interestingly, these differences were noticeable in women but not in men.

Also, associations between changes in after-exercise systolic blood pressure and changes in resting heart rate were observed in our sample. Apart from being an independent factor for cardiovascular morbidity and mortality, elevated heart rate has been described to be related to elevated peripheral blood pressure (Reule and Drawz, 2012) and also to be associated with the onset of hypertension (Palatini, 2011). Despite several complex mechanisms could be behind this association, it appears that the negative effects produced by an increased heart rate in the cardiovascular system including impaired endothelial function, decreased shear stress and a consequent reduction in vascular compliance (Custodis et al., 2010), are believed to be responsible for increases in blood pressure (Manfredini et al., 2009). Therefore, the beneficial effect of exercise on vascular stiffness (Havlik et al., 2005) and on endothelium-induced vasodilation (Manfredini et al., 2009) could explain the improvements of both blood pressure and heart rate. Nonetheless, it is important to consider that the changes observed in heart rate were not statistically significant, thus, these results should be interpreted with caution.

5.5. Limitations

There are several limitations in this study that need to be considered. The main limitation of this study is its retrospective design. Secondly, problems related with the measurement of variables such as inaccuracies caused by measurement tools among others. Next, inconsistent adherence also played an important role on the amount of data collected for each participant. Finally, issues related with funding obstructed the development of fundamental evaluation procedures.

5.5.1. Design

The retrospective design of this study has several limitations that could have affected the results. Firstly, it relied on the accuracy of the written records and for this reason, important data were missed. Second, the sample was biased as the participants were specifically selected by their family doctor and were self-motivated to participate in the program, thus these participants cannot be considered representative of the general population of the Basque Country. It is also possible that misclassification may have occurred due to difficulties in categorizing the participants according to their risk factors, considering that many of them had multiple.

Also, the absence of a control group and the impossibility of performing a randomization hampered the possibility of controlling for possible bias and confounders. Hence, the risk that the effects observed were provoked by other variables other than the intervention or the difficulty to discern if the observed effects could have been equally detected in subjects not taking part in the exercise program. For instance, the several informative workshops related with different disorders, physical activity and nutrition could have encouraged independent physical activity and possibly influence the results related with the physical condition.

Especially in the early stages of the program, considering that a maximum participation was prioritized rather than a rigorous recruitment process, participants were allowed to start anytime regardless if the program had already started. These and other design flaws explained in the following paragraphs were handled and resolved along the years but could have also affected the results.

5.5.2. Measurement

Among the variables used to measure the physical condition of the participants, fundamental variables related to MSD were not taken into account. Considering the different subgroups formed under MSD, including osteoarthritis, osteoporosis and fibromyalgia, more individualized follow-up test could have been administered in order to assess the effect of physical activity in key outcome measures related with these disorders such as strength, balance, pain, fatigue, quality of life or range of movement (Beckwee et al., 2012; Pedersen and Saltin, 2006).

Also, even though attempts to measure glycemia in diabetic participants were made, these measurements were not performed rigorously and did not lead to any relevant conclusions apart from the acute effect of physical activity reducing blood glucose levels right after exercise (O'Hagan, De Vito and Boreham, 2013).

Furthermore, motivation and satisfaction were measured by self-designed questionnaires which had not been rigorously tested for validity or reliability. Moreover, these self-report questionnaires could have produced a considerable measurement error (Field, 2013) considering that they were self-administered instead of interviewer administered and also possibly subject to social desirability bias (Mortel, 2008).

In addition, despite the main aim of improving symptoms of different chronic disorders was evaluated, some other specific objectives of the program were not measured or appropriate tools were not used for this purpose. In order to evaluate the increase in participants´ knowledge about their disorder and nutrition, self-designed questionnaires were used to assess initial knowledge but were not repeated afterwards hampering the possibility of estimating any learning. Similarly, independent participation in physical activity continuing the program was vaguely assessed controlling assistance in few of the open classes offered; however, the creation of walking groups and the assistance to supervised exercise lessons offered by the city council were not controlled. Thus, it could be difficult to ascertain to what extent the program increased autonomous independent physical participation.

5.5.3. Adherence

A considerable amount of data was missing due to the absence of participants on the data collection dates. As previously mentioned, apart from the health problems that might have caused low adherence in some participants, the exact reasons under “personal issues” are unknown. Also, and related with the design of the study, the community feeling of the program could have undermined the compromise of the participants if compared to the compromise that participants might have taken in a study with a more structured design. Nevertheless, the elucidation of the exact reasons for attrition deserves further attention in order to determine approaches to improve adherence in prospective programs.

5.5.4. Funding

The cessation of funding in the late stages of the program caused the immediate termination of the intervention and consequently hampered the possibility of continuing the analysis and evaluation of important aspects of the program. The impact of the intervention on physical activity independent participation and on the decrease of primary care visits and medication consumption was not possible to be fully performed due to this lack of means and support.

5.6. Strengths

The main strength of this study is the extensive duration of the data collection which allowed a great number of individuals with chronic disorders to profit and learn from the benefits of physical activity. Consequently, a large sample size was possible to be collected for analysis purposes. This was mainly possible due to the efforts of the sports medicine centre staff, including doctors, nurses and physical activity professionals in the design, promotion and delivery of the program along several years. Also, the involvement of the city council was considered vital as without the appropriate funding the development of this program could not have been possible.

Additionally, the successful partnership and collaboration between the primary care system and the sport and physical activity professionals also appears to be fundamental in the recruitment of participants. As others have confirmed, this referral system appears to be appropriate as the target population of this type of programs, sedentary individuals and those suffering from chronic disorders, generally have a relationship of trust with their family doctor, who could positively influence physical activity or exercise initiation on their patients (Garriga et al., 2013).

Also, the length of the exercise intervention and the type of exercise, which combined endurance and resistance exercise, appeared to be adequate for the target population. Apart from being effective in improving different measures related with health benefits, it also showed to be appealing and enjoyable for the participants. In the same way, another important aspect to consider is the high satisfaction that participants showed and their willingness to continue participating in the program.

Moreover, apart from the main objective of improving health, quality of life and symptoms related with different chronic disorders, an important aspect of the program was also the support towards independent participation in physical activity and exercise. For this purpose, the creation of walking groups and the participation in regular supervised exercise lessons offered by the city council were encouraged. Additionally, workshops related to different topics including chronic disorders, the beneficial effects of physical activity and nutrition were offered to the participants. All these initiatives are considered fundamental in the promoting of a healthy and active living.

As mentioned before, despite the results are not generalizable to other populations due to fundamental study design issues, the findings of this study reveal crucial benefits on the physical condition and quality of life of individuals with diverse chronic disorders and offer insight into the development of future interventions.

5.7. Future recommendations

Considering the important implications of this intervention in the physical condition and quality of life of individuals with different chronic conditions, it appears fundamental to suggest some directions in which to extend the present research.

Regarding outcome measures related to the physical condition, some modifications and additions would be recommended. For instance, flexibility of the extensor muscles of the trunk and the hamstrings was measured by the “Sit-and-reach” bench. However, considering that the majority of the participants of the program were older and that some of these individuals may experience discomfort sitting on the floor, the modified version of Rikli and Jones (2013) performed in a chair (“Chair Sit-and-reach” test) could be considered more appropriate.

As previously indicated, the addition of several measures to assess factors related with different MSD would also be beneficial. Pain, muscle strength, balance and physical function appear to be common outcome measures in most MSD (Pedersen and Saltin, 2006), in addition to more specific measures for fibromyalgia such as fatigue and depression (Busch et al., 2011), bone mineral density for osteoporosis (Warburton et al., 2010) and range of motion for osteoarthritis and rheumatoid arthritis (Beckwee et al., 2012; Inversen, Braweman and Inversen, 2012).

Also, to evaluate the effect of physical activity on diabetic individuals outcome measures such as HbA_{1c} , a key marker for long-term glycaemic control (O´Hagan, De Vito and Boreham, 2013), fasting glucose, glucose tolerance or insulin-resistance index (Aguiar et al., 2014) could be included.

Quality of life could be assessed using internationally validated instruments such as the The World Health Organization Quality of Life questionnaire (WHOQOL) or the SF-36 (Ware and Kosinski, 2001). Also, among many other validated instruments available, the Motives for Physical Activity Measure-Revised questionnaire (MPAM-R) (Ryan et al., 1997) for assessing motives for participating in physical activity, the Physical Activity Enjoyment Scale (PACES) (Kendzierski and De Carlo, 1991) or various scales to evaluate self-efficacy and exercise (Marcus et al., 1992; Garcia and King, 1991; Sallis et al., 1988) could be used in order to allow comparisons among other studies.

The assessment of the impact of the intervention on the amount of primary care visits and on medication consumption could also be very appropriate and relevant in terms of public health.

Finally, it is vital to underline the fundamental paper that institutions play in the completion of interventions and research of this kind. Funding and support appear to be indispensable in order to guarantee the adequate initiation, development and evaluation of these studies.

The efforts placed in the prevention and promotion of health will ensure the avoidance or delay of chronic conditions and improve the quality of life of our society.

CONCLUSIONS

6. CONCLUSIONS

1. The general characteristics of the sample revealed a high proportion of overweight and obese individuals in all groups, particularly in men. Also, and an increasing trend of BMI as age increased was observed. Moreover, a great proportion of participants showed a waist circumference that could contribute to an increased risk of metabolic complications and CVD. Besides, the cardio-metabolic multimorbidity pattern known as “metabolic syndrome” was also detected among our participants. These outcomes emphasize the need for strategies to improve body composition and to reduce metabolic disorders, CV risk factors and mortality associated with obesity.

2. The mechanical-obesity multimorbidity pattern observed, with a great proportion of overweight and obese individuals also suffering from mechanical disorders of the musculoskeletal system, deserves some consideration especially when assessing the impact of different comorbidities in the quality of life of obese individuals.

3. In accordance with the general population, the onset of type 2 diabetes and hypertension in our participants was detected to start in the 41-50 age group. In addition, the prevalence of chronic conditions was observed to increase with age. Also, musculoskeletal disorders such as fibromyalgia and osteoporosis were found to have a greater prevalence in women if compared to men. For all these reasons, preventive strategies at early age and individualized interventions to reduce the impact of these conditions in the older population already suffering from these disorders appear indispensable.

4. Among hypertensive participants a great percentage were found to have a non-controlled blood pressure, an important issue to be tackled particularly in primary care. Also, after-exercise values of both systolic and diastolic blood pressure were found to be slightly lower than the resting values, confirming the immediate blood pressure lowering effect of physical activity and highlighting the beneficial effects of single bouts of exercise.

5. Heart rate levels in different subgroups revealed to be close and above the 80 bpm threshold believed to lead to an increased mortality risk. An association between diabetes and increased heart rate was also detected. Therefore, heart rate appears be an important marker to be considered in the diagnosis of diabetes and the estimation of CV risk.

6. Women were found to be more flexible than men and younger individuals were found to be more flexible than older individuals. These differences in flexibility deserve individualized consideration when designing programs for diverse population groups. On the other hand, the whole sample showed a poor cardiorespiratory fitness showing an inmediate need to increase the fitness levels of the population described.

7. Disparities in participation and adherence among subgroups could be explained by the differences in motives for participation in physical activity, which are known to vary across gender, age and type of activity, and also by differences in motivational readiness to change across individuals. However, the different barriers that could have affected participation and adherence are not completely identified. Therefore, this area deserves further attention in order to develop interventions that warrant high levels of participation and adherence in both genders and across all age groups.

8. Continuous and uninterrupted participation revealed better results if compared to the results obtained with a break in between, possibly explained by a detraining effect occurred during this period. Hence the importance of regular physical activity performed at appropriate intensities in order to compensate inactivity periods caused by health problems or by other barriers to physical activity participation.

9. The whole sample and women showed statistically significant changes in most of the variables except in hear rate. On the other hand, men showed fewer statistically significant changes which could be due to motivational reasons previously mentioned or other causes that would need to be clarified.

10. Although statistically significant, very small effect sizes were found in all body composition outcomes. However, inter-individual variation illustrated by large standard deviations should be taken into account as could have implied important reductions in some individuals. Yet, the elucidation of the reasons responsible for this lack of change in some individuals appears fundamental in the control and treatment of obesity. Nevertheless, it is important to

consider that the reductions in blood pressure occurred independent of body composition changes, which highlights the importance of physical activity regardless of weight loss. The lack of significant reductions in heart rate also deserves additional exploration considering the association between elevated heart rate and increase risk in mortality.

11. Reductions of 5 mmHg in systolic and diastolic blood pressure after nine months underline the valuable impact of physical activity in reducing risk of CVD and all-cause mortality. Also, changes in blood pressure did not differ between women and men or among age groups, an important aspect when assessing the effectiveness of different programs in different population groups.

12. Improvements in cardiorespiratory fitness were modest but statistically significant and they could be clinically relevant for some individuals. Nevertheless, the minor improvements in the oldest group deserve further investigation in order to elucidate if this lack of effect was caused by an age-related faster decline of VO_{2max} or other reasons. The reduced response in the increase of cardiorespiratory fitness observed in hypertensive individuals possibly caused by anti-hypertensive medication also deserves some consideration as cardiorespiratory fitness is believed to reduce CV mortality and lower the incidence of risk factors.

13. Noticeable improvements in hamstring flexibility were observed already at three months which could be relevant as key contributor to functional status. Similarly, significant changes in blood pressure at three months emphasize the short-term benefits of physical activity. Nevertheless, the greater changes observed after nine months confirmed the dose-response association between physical activity and different health-related variables.

14. A strong relationship between systolic and diastolic blood pressure reductions was observed. Moreover, associations between changes in after-exercise systolic blood pressure and resting heart rate were found which underlines the beneficial effect of exercise on vascular parameters such as vascular stiffness and endothelium-induced vasodilation.

REFERENCES

REFERENCES

Aguiar, E. J., Morgan, P. J., Collins, C. E., Plotnikoff, R. C., & Callister, R. (2014). Efficacy of interventions that include diet, aerobic and resistance training components for type 2 diabetes prevention: A systematic review with meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity, 11*, 2-5868-11-2.

Ahima, R. S. (2011). Digging deeper into obesity. *The Journal of Clinical Investigation, 121*(6), 2076-2079.

American College of Sports Medicine (2004). ACSM reviews evidence on exercise and hypertension. *The Physician and Sports Medicine, 32*(4).

American College of Sports Medicine (2014). *ACSM´s Guidelines for Exercise Testing and Prescription*. 9th ed. Baltimore: American College of Sports Medicine.

American Thoracic Society (2002). ATS statement: guidelines for the six-minute walk test. *Am J Respir Crit Care Med*, 166, 111–17.

Annesi, J. J. (2013). Association of multimodal treatment-induced improvements in stress, exercise volume, nutrition, and weight with improved blood pressure in severely obese women. *International Journal of Behavioral Medicine, 20*(3), 397-402.

Ansari, R. M. (2009). Effect of physical activity and obesity on type 2 diabetes in a middle-aged population. *Journal of Environmental and Public Health,* n/a-195285.

Antelmi, I., de Paula, R. S., Shinzato, A. R., Peres, C. A., Mansur, A. J., & Grupi, C. J. (2004). Influence of age, gender, body mass index, and functional capacity on heart rate variability in a cohort of subjects without heart disease. *The American Journal of Cardiology, 93*(3), 381-385.

Avila, J. J., Gutierres, J. A., Sheehy, M. E., Lofgren, I. E., & Delmonico, M. J. (2010). Effect of moderate intensity resistance training during weight loss on body composition and physical performance in overweight older adults. *European Journal of Applied Physiology, 109*(3), 517-25.

Barbosa, A. R., Santarem, J. M., Filho, W. J., & Marucci Mde, F. (2002). Effects of resistance training on the sit-and-reach test in elderly women. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 16*(1), 14-18.

Bateman, L. A., Slentz, C. A., Willis, L. H., Shields, A. T., Piner, L. W., Bales, C. W., et al. (2011). Comparison of aerobic versus resistance exercise training effects on metabolic syndrome (from the studies of a targeted risk reduction intervention through defined exercise - STRRIDE-AT/RT). *The American Journal of Cardiology, 108*(6), 838-844.

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J. F., & Martin, B. W. (2012). Physical activity 2: Correlates of physical activity: Why are some people physically active and others not? *The Lancet, 380* (9838), 258-71.

Bayego, E. S., Vila, G.S., Martínez, I.S. (2012). Prescripción de ejercicio físico: indicaciones, posología y efectos adversos. *Medicina Clínica*, 138(1), 18-24.

Beavers, K. M., Beavers, D. P., Nesbit, B. A., Ambrosius, W. T., Marsh, A. P., Nicklas, B. J., et al. (2014). Effect of an 18-month physical activity and weight loss intervention on body composition in overweight and obese older adults. *Obesity (Silver Spring, Md.), 22*(2), 325-331.

Beckwee, D., Vaes, P., Cnudde, M., Swinnen, E., & Bautmans, I. (2013). Osteoarthritis of the knee: Why does exercise work? A qualitative study of the literature. *Ageing Research Reviews, 12*(1), 226-236.

Belza, B., Walwick, J., Schwartz, S., LoGerfo, J., Shiu-Thornton, S., & Taylor, M. (2004). Older Adult Perspectives on Physical Activity and Exercise: Voices From Multiple Cultures. *Preventing Chronic Disease*, 1(4), A09.

Bird, M., Hill, K. D., Ball, M., Hetherington, S., & Williams, A. D. (2011). The long-term benefits of a multi-component exercise intervention to balance and mobility in healthy older adults. *Archives of Gerontology and Geriatrics, 52*(2), 211-216.

Brakke, R., Singh, J., & Sullivan, W. (2012). Physical therapy in persons with osteoarthritis. *Physical Medicine and Rehabilitation, 4,* S53-S58.

Brito Ade, F., de Oliveira, C. V., Santos Mdo, S., & Santos Ada, C. (2014). High-intensity exercise promotes postexercise hypotension greater than moderate intensity in elderly hypertensive individuals. *Clinical Physiology and Functional Imaging, 34*(2), 126-132.

Brooks, P. M. (2006). The burden of musculoskeletal disease--a global perspective. *Clinical Rheumatology, 25*(6), 778-781.

Bruce, T. O. (2008). Comorbid depression in rheumatoid arthritis: Pathophysiology and clinical implications. *Current Psychiatry Reports, 10*(3), 258-264.

Brun, J., Bordenave, S., Mercier, J., Jaussent, A., Picot, M., & Préfaut, C. (2008). Cost-sparing effect of twice-weekly targeted endurance training in type 2 diabetics: A one-year controlled randomized trial. *Diabetes & Metabolism, 34* (3), 258-265.

Busch, A. J., Webber, S. C., Brachaniec, M., Bidonde, J., Bello-Haas, V. D., Danyliw, A. D., Schachter, C. L. (2011). Exercise Therapy for Fibromyalgia. *Current Pain and Headache Reports*, 15(5), 358–367.

Cadenas-Sanchez, C., & Ruiz-Ruiz, J. (2014). Effect of a physical activity programme in patients with fibromyalgia: A systematic review. Efecto de un programa de actividad física en pacientes con fibromialgia: revisión sistemática. *Medicina Clinica, 143*(12), 548-553.

Cairns, A. P. & Mcveigh, J. G. (2009). A systematic review of the effects of dynamic exercise in rheumatoid arthritis. *Rheumatology International, 30*(2), 147-58.

Cancela Carral, J. M., & Ayan Perez, C. (2007). Effects of high-intensity combined training on women over 65. *Gerontology, 53*(6), 340-346.

Capodaglio, P., De Souza, S. A., Parisio, C., Precilios, H., Vismara, L., Cimolin, V., et al. (2013). Reference values for the 6-min walking test in obese subjects. *Disability and Rehabilitation, 35*(14), 1199-1203.

Carnethon, M. R., Yan, L., Greenland, P., Garside, D. B., Dyer, A. R., Metzger, B., et al. (2008). Resting heart rate in middle age and diabetes development in older age. *Diabetes Care, 31*(2), 335-9.

Carter, J.B., Banister, E.W., Blaber, A.P. (2003). Effect of Endurance Exercise on Autonomic Control of Heart Rate. *Sports Medicine*, 33(1), 33-46.

Carter, R., & Watenpaugh, D. E. (2008). Obesity and obstructive sleep apnea: Or is it OSA and obesity? *Pathophysiology, 15*(2), 71-77.

Carvalho, M. J., Marques, E., & Mota, J. (2009). Training and detraining effects on functional fitness after a multicomponent training in older women. *Gerontology, 55*(1), 41-48.

Casanova, C., Celli, B. R., Barria, P., Casas, A., Cote, C., de Torres, J. P., et al. (2011). The 6-min walk distance in healthy subjects: Reference standards from seven countries. *European Respiratory Journal, 37*(1), 150-156.

Cecchini, M., Sassi, F., Lauer, J. A., Lee, Y. Y., Guajardo-Barron, V., & Chisholm, D. (2010). Chronic diseases: Chronic diseases and development 3: Tackling of unhealthy diets, physical inactivity, and obesity: Health effects and cost-effectiveness. *The Lancet, 376*(9754), 1775-84.

Ceria-Ulep, C. D., Serafica, R. C., & Tse, A. (2011). Filipino older adults' beliefs about exercise activity. *Nursing Forum, 46*(4), 240-250.

Church, T. S., Blair, S. N., Cocreham, S., Johannsen, N., Johnson, W., Kramer, K., et al. (2010). Effects of aerobic and resistance training on hemoglobin A1c levels in patients with type 2 diabetes: A randomized controlled trial. *Jama, 304*(20), 2253-2262.

Church, T. S., Martin, C. K., Thompson, A. M., Earnest, C. P., Mikus, C. R., & Blair, S. N. (2009). Changes in weight, waist circumference and compensatory responses with different doses of exercise among sedentary, overweight postmenopausal women. *PloS One, 4*(2).

Coca Payeras, A. (2005). Evolución del control de la hipertensión arterial en atención primaria en España. Resultados del estudio Controlpres 2003. *Hipertensión*, 22(1), 5-14.

Colberg, S. R. (2012). Physical activity: The forgotten tool for type 2 diabetes management. *Frontiers in Endocrinology, 3*, 70.

Collier, S. R., Kanaley, J. A., Carhart, R. Jr, Frechette, V., Tobin, M.M., et al. (2008). Effect of 4 weeks of aerobic or resistance exercise training on arterial stiffness, blood flow and blood pressure in pre- and stage-1 hypertensives. *Journal of Human Hypertension*, 22, 678-686.

Conn, Vicki S, Valentine, J. C., & Cooper, H. M. (2002). Interventions to increase physical activity among aging adults: A meta-analysis. *Annals of Behavioral Medicine, 24*(3), 190-200.

Cooney, M. T., Vartiainen, E., Laatikainen, T., Juolevi, A., Dudina, A., & Graham, I. M. (2010). Elevated resting heart rate is an independent risk factor for cardiovascular disease in healthy men and women. *American Heart Journal, 159*(4), 612-619.

Cooper, A. J., Brage, S., Ekelund, U., Wareham, N. J., Griffin, S. J., & Simmons, R. K. (2014). Association between objectively assessed sedentary time and physical activity with metabolic risk factors among people with recently diagnosed type 2 diabetes. *Diabetologia, 57*(1), 73-82.

Cornelissen, V. A., & Smart, N. A. (2013). Exercise training for blood pressure: A systematic review and meta-analysis. *Journal of the American Heart Association, 2*(1).

Cox, K. L., Burke, V., Morton, A. R., Gillam, H. F., Beilin, L. J., & Puddey, I. B. (2001). Long-term effects of exercise on blood pressure and lipids in healthy women aged 40-65 years: The sedentary women exercise adherence trial (SWEAT). *Journal of Hypertension, 19*(10), 1733-1743.

Creager, M.A., Lüscher, T.F., Cosentino, F., Beckman, J.A. (2003). Diabetes and Vascular Disease Pathophysiology, Clinical Consequences, and Medical Therapy: Part I. *Circulation*, 108, 1527-1532.

Custodis, F., Schirmer, S. H., Baumhäkel, M., Heusch, G., Böhm, M., & Laufs, U. (2010). Vascular pathophysiology in response to increased heart rate. *Journal of the American College of Cardiology, 56*(24), 1973-1983.

Dall, T. M., Gallo, P., Koenig, L., Gu, Q., & Ruiz, D. (2013). Modeling the indirect economic implications of musculoskeletal disorders and treatment. *Cost Effectiveness and Resource Allocation, 11*(1), 5-7547-11-5.

Davidson, L.E., Hudson, R., Kilpatrick, K., et al. (2009). Effects of exercise modality on insulin resistance and functional limitation in older adults: A randomized controlled trial. *Archives of Internal Medicine, 169*(2), 122-131.

De Koning, L., Merchant, A. T., Pogue, J., & Anand, S. S. (2007). Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: Meta-regression analysis of prospective studies. *European Heart Journal, 28*(7), 850-856.

Department of Health and Consumer Affairs of the Basque Government and Osakidetza (2010). *A strategy to tackle the challenge of chronicity in the Basque country*. Available at: http://www.rafaelbengoa.com/wp-content/uploads/cronicidad/ChronicityBasqueCountry.pdf (Accessed: 17 May 2015)

Departamento de Sanidad y Consumo del Gobierno Vasco y Osakidetza (2012). *País Vasco: transformando el Sistema de Salud 2009-2012*. Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

Di Domenica, F., Sarzi-Puttini, P., Cazzola, M., Atzeni, F., Cappadonia, C., Caserta, A., et al. (2005). Physical and rehabilitative approaches in osteoarthritis. *Seminars in Arthritis and Rheumatism, 34*(6 Suppl 2), 62-69.

Donnelly, J.E., Blair, S.N., Jakicic, J.M., Manore, M.M., Rankin, J.W., Smith, B.K. (2009). American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and Science in Sports and Exercise*, 41(2), 459-471.

Ekman, M. J., Klintenberg, M., Björck, U., Norström, F., & Ridderstråle, M. (2013). Six-minute walk test before and after a weight reduction program in obese subjects. *Obesity, 21*(3), E236-E243.

Ernsth-Bravell M., Zarit S. H., Johansson B. (2011). Self-reported activities of daily living and performance-based functional ability: A study of congruence in the oldest-old. *European Journal of Ageing*, 8, 199–209.

Esnaola, S., de Diego, M., Elorriaga, E., Martín, U., Bacigalupe, A., Calvo, M., Aldasoro, E., Pardillo, B. (2013). *Datos relevantes de la Encuesta de Salud del País Vasco 2013*. Vitoria-Gasteiz: Departamento de Salud, Servicio de Estudios e Investigación Sanitaria.

Fagard, R., Staessen, J., Thijs, L., & Amery, A. (1993). Influence of antihypertensive drugs on exercise capacity. *Drugs, 46 Suppl 2*, 32-36.

Fatouros, I. G., Kambas, A., Katrabasas, I., Leontsini, D., Chatzinikolaou, A., Jamurtas, A. Z., et al. (2006). Resistance training and detraining effects on flexibility performance in the elderly are intensity-dependent. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 20*(3), 634-642.

Fenkci, S., Sarsan, A., Rota, S., Ardic, F. (2006). Effects of Resistance or Aerobic Exercises on Metabolic Parameters in Obese Women Who Are Not on a Diet. *Advances in Therapy*, 23 (3), 404-413.

Field, A. (2013). Discovering Statistic using IBM SPSS Statistics. 4th ed. London: Sage Publications.

Fogelholm, M., Stallknecht, B. and Van Baak, M. (2006). ECSS position statement: Exercise and Obesity. *European Journal of Sport Science*, 6(1), 15-24.

Fontaine, K., Conn, L., & Clauw, D. (2010). Effects of lifestyle physical activity on perceived symptoms and physical function in adults with fibromyalgia: Results of a randomized trial. *Arthritis Research & Therapy, 12*(2), R55.

Foster-Schubert, K. E., Alfano, C. M., Duggan, C. R., Xiao, L., Campbell, K,L., et al. (2012). Effect of diet and exercise, alone or combined, on weight and body composition in overweight-to-obese postmenopausal women. *Obesity*, 20, 1628-1638.

Fox, K., Borer, J. S., Camm, A. J., Danchin, N., Ferrari, R., Lopez Sendon, J. L., et al. (2007). Resting heart rate in cardiovascular disease. *Journal of the American College of Cardiology, 50*(9), 823-830.

Freak-Poli, R. L., Wolfe, R., Walls, H., Backholer, K., & Peeters, A. (2011). Participant characteristics associated with greater reductions in waist circumference during a four-month, pedometer-based, workplace health program. *BMC Public Health, 11*, 824-2458-11-824.

Garmendia, M. L., Dangour, A., Albala, C., Eguiguren, P., Allen, E., & Uauy, R. (2013). Adherence to a physical activity intervention among older adults in a post-transitional middle income country: A quantitative and qualitative analysis. *The Journal of Nutrition, Health & Aging, 17*(5), 466-471.

Gill, J. M. R., & Cooper, A. R. (2008). Physical activity and prevention of type 2 diabetes mellitus. *Sports Medicine, 38*(10), 807-24.

Gine-Garriga, M., Martin-Borras, C., Puig-Ribera, A., Martin-Cantera, C., Sola, M., Cuesta-Vargas, A., et al. (2013). The effect of a physical activity program on the total number of primary care visits in inactive patients: A 15-month randomized controlled trial. *PloS One, 8*(6), e66392.

Gobierno Vasco (2013a). *Encuesta de Salud del País Vasco 2013. Estado de salud*. Available at: http://www.osakidetza.euskadi.eus/contenidos/informacion/encuesta_salud_resultados/es_escav13/adjuntos/Estado%20de%20salud.pdf (Accessed: May 17 2015)

Gobierno Vasco (2013b). *Encuesta de Salud del País Vasco 2013. Determinantes de la salud*. Available at: http://www.osakidetza.euskadi.eus/contenidos/informacion/encuesta_salud_resultados/es_escav13/adjuntos/Determinantes%20de%20la%20salud.pdf (Accessed: May 17 2015)

Gopi, S. M., Neeta J. V., Megha S. S. (2014). Correlation of hamstrings flexibility with age and gender in subjects having chronic low back pain. *International Journal of Therapies and Rehabilitation Research*, 3 (4), 31-38.

Graham, I., Atar, D., Borch-Johnsen, K., Boysen, G., Burell, G., Cifkova, R., et al. (2007). European guidelines on cardiovascular disease prevention in clinical practice: Executive summary. *Atherosclerosis, 194*(1), 1-45.

Grandes, G., Sanchez, A., Torcal, J., Sanchez-Pinilla, R. O., Lizarraga, K., Serra, J., et al. (2008). Targeting physical activity promotion in general practice: Characteristics of inactive patients and willingness to change. *BMC Public Health, 8*, 172-2458-8-172.

Grantham, N. M., Magliano, D. J., Tanamas, S. K., Söderberg, S., Schlaich, M. P., & Shaw, J. E. (2013). Higher heart rate increases risk of diabetes among men: The australian diabetes obesity and lifestyle (AusDiab) study. *Diabetic Medicine, 30*(4), 421-7.

Hallage, T., Krause, M. P., Haile, L., Miculis, C. P., Nagle, E. F., Reis, R. S., et al. (2010). The effects of 12 weeks of step aerobics training on functional fitness of elderly women. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 24*(8), 2261-2266.

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., et al. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *Lancet, 380*(9838), 247-257.

Hansen, D., Meeusen, R., Mullens, A., & Dendale, P. (2012). Effect of acute endurance and resistance exercise on endocrine hormones directly related to lipolysis and skeletal muscle protein synthesis in adult individuals with obesity. *Sports Medicine, 42*(5), 415-31.

Harris, C., DeBeliso, M., Adams, K. J., Irmischer, B. S., & Spitzer Gibson, T. A. (2007). Detraining in the older adult: Effects of prior training intensity on strength retention. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 21*(3), 813-818.

Havlik, R. J., Phillips, C. L., Brock, D. B., Lohman, K., Haskell, W., Snell, P., et al. (2005). Walking may be related to less vascular stiffness in the activity counseling trial (ACT). *American Heart Journal, 150*(2), 270-275.

Heitmann, B. L., Hills, A. P., Frederiksen, P., & Ward, L. C. (2009). Obesity, leanness, and mortality: Effect modification by physical activity in men and women. *Obesity (Silver Spring, Md.), 17*(1), 136-142.

Henwood, T. R., & Taaffe, D. R. (2008). Detraining and retraining in older adults following long-term muscle power or muscle strength specific training. *The Journals of Gerontology.Series A, Biological Sciences and Medical Sciences, 63*(7), 751-758.

Howe, T. E., Shea, B., Dawson, L. J., Downie, F., Murray, A., Ross, C., et al. (2011). Exercise for preventing and treating osteoporosis in postmenopausal women. *The Cochrane Database of Systematic Reviews, (7).*

Ibanez, J., Izquierdo, M., Martinez-Labari, C., Ortega, F., Grijalba, A., Forga, L., et al. (2010). Resistance training improves cardiovascular risk factors in obese women despite a significative decrease in serum adiponectin levels. *Obesity (Silver Spring, Md.), 18*(3), 535-541.

Instituto Nacional de Estadística (2012). *National Health Survey 2011-2012. Health determiners. Body Mass Index of the adult population, by sex and Autonomous Community. Population aged 18 years old and over*. Available at: http://www.ine.es/jaxi/tabla.do?path=/t15/p419/a2011/p06/l1/&file=06004.px&type=pcaxis&L=1 (Accessed: 18 February 2015)

Instituto Nacional de Estadística (2014). *European Survey of Health in Spain 2014. Chronic Diseases. Enfermedades crónicas. Chronic problems or diseases or of long evolution in the last 12 months and diagnosed by a doctor. Population aged 15 years old and over*. Available at: http://www.ine.es/jaxi/tabla.do?path=/t15/p420/a2014/p04/l1/&file=02016.px&type=pcaxis&L=1 (Accessed: 18 February 2015)

Iversen, M. D., Brawerman, M., & Iversen, C. N. (2012). Recommendations and the state of the evidence for physical activity interventions for adults with rheumatoid arthritis: 2007 to present. *International Journal of Clinical Rheumatology, 7*(5), 489-503.

Jakicic, J. M., & Otto, A. D. (2005). Physical activity considerations for the treatment and prevention of obesity. *The American Journal of Clinical Nutrition, 82*(1 Suppl), 226S-229S.

Jancey, J., Lee, A., Howat, P., Clarke, A., Wang, K., & Shilton, T. (2007). Reducing attrition in physical activity programs for older adults. *Journal of Aging and Physical Activity, 15*(2), 152-165.

Jeon, C. Y., Lokken, R. P., Hu, F. B., & Van Dam, R. M. (2007). Physical activity of moderate intensity and risk of type 2 diabetes: A systematic review. *Diabetes Care, 30*(3), 744-52.

Kalapotharakos, V. I., Michalopoulos, M., Tokmakidis, S. P., Godolias, G., & Gourgoulis, V. (2005). Effects of a heavy and a moderate resistance training on functional performance in older adults. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 19*(3), 652-657.

Kawano, H., Tanimoto, M., Yamamoto, K., Sanada, K., Gando, Y., Tabata, I., et al. (2008). Resistance training in men is associated with increased arterial stiffness and blood pressure but does not adversely affect endothelial function as measured by arterial reactivity to the cold pressor test. *Experimental Physiology, 93*(2), 296-302.

Kemmler, W., von Stengel, S., Engelke, K., Häberle, L., & Kalender, W. A. (2010). Exercise effects on bone mineral density, falls, coronary risk factors, and health care costs in older women: The randomized controlled senior fitness and prevention (SEFIP) study. *Archives of Internal Medicine, 170*(2), 179.

Kim, T. H., Eke Dogra, S., Al-Sahab, B., & Tamim, H. (2014). Comparison of functional fitness outcomes in experienced and inexperienced older adults after 16-week tai chi program. *Alternative Therapies in Health and Medicine, 20*(3), 20-25.

King, N. A., Hopkins, M., Caudwell, P., Stubbs, R. J., & Blundell, J. E. (2008). Individual variability following 12 weeks of supervised exercise: Identification and characterization of compensation for exercise-induced weight loss. *International Journal of Obesity (2005), 32*(1), 177-184.

Koeneman, M. A., Verheijden, M. W., Chinapaw, M., & Hopman-Rock, M. (2011). Determinants of physical activity and exercise in healthy older adults: A systematic review. *Int J Behav Nutr Phys Act, 8*(1), 142.

Kokkinos, P., Chrysohoou, C., Panagiotakos, D., Narayan, P., Greenberg, M., & Singh, S. (2006). Beta-blockade mitigates exercise blood pressure in hypertensive male patients. *Journal of the American College of Cardiology, 47*(4), 794-798.

Krueger, H., Turner, D., Krueger, J., & Ready, A. E. (2014). The economic benefits of risk factor reduction in canada: Tobacco smoking, excess weight and physical inactivity. *Canadian Journal of Public Health = Revue Canadienne De Sante Publique, 105*(1), e69-78.

Laaksonen, D. E., Lindström, J., Lakka, T. A., Eriksson, J. G., & et al. (2005). Physical activity in the prevention of type 2 diabetes: The finnish diabetes prevention study. *Diabetes, 54*(1), 158-65.

Ladage, D., Schwinger, R. H., & Brixius, K. (2013). Cardio-selective beta-blocker: Pharmacological evidence and their influence on exercise capacity. *Cardiovascular Therapeutics, 31*(2), 76-83.

Lavie, C. J., Milani, R. V., & Ventura, H. O. (2009). Obesity and cardiovascular disease: Risk factor, paradox, and impact of weight loss. *Journal of the American College of Cardiology, 53*(21), 1925-1932.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., et al. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet, 380*(9838), 219-229.

Li, Y., Sun, C., Li, L., Wang, L., Guo, Y., You, A., et al. (2014). Resting heart rate as a marker for identifying the risk of undiagnosed type 2 diabetes mellitus: A cross-sectional survey. *BMC Public Health, 14*, n/a-1052.

Liu-Ambrose, T., Khan, K. M., Eng, J. J., Janssen, P. A., & et al. (2004). Resistance and agility training reduce fall risk in women aged 75 to 85 with low bone mass: A 6-month randomized, controlled trial. *Journal of the American Geriatrics Society, 52*(5), 657-665.

Loew, L., Brosseau, L., Wells, G. A., Tugwell, P., Kenny, G. P., Reid, R., et al. (2012). Ottawa panel evidence-based clinical practice guidelines for aerobic walking programs in the management of osteoarthritis. *Archives of Physical Medicine and Rehabilitation, 93*(7), 1269-1285.

Mancia, G., Fagard, R., Narkiewicz, K., Redon, J., Zanchetti, A., Bohm, M., Christiaens, T., Cifkova, R., De Backer, G., Dominiczak, A., Galderisi, M., Grobbee, D. E., Jaarsma, T., Kirchhof, P., Kjeldsen, S.E., Laurent, S., Manolis, A. J., Nilsson, P.M., Ruilope, L.M., Schmieder, R.E., Sirnes, P.A., Sleight, P., Viigimaa, M., Waeber, B., Zannad, F. Task Force Members (2013). 2013 ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Journal of Hypertension*, 31(7), 1281-1357.

Mandai, N., Akazawa, K., Hara, N., Ide, Y., Ide, K., Dazai, U., et al. (2015). Body weight reduction results in favorable changes in blood pressure, serum lipids, and blood sugar in middle-aged japanese persons: A 5-year interval observational study of 26,824 cases. *Global Journal of Health Science, 7*(5), 43204.

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*(2), 207-216.

Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport*, 63(1), 60–66.

McTiernan, A., Sorensen, B., Irwin, M. L., Morgan, A., Yasui, Y., Rudolph, R. E., et al. (2007). Exercise effect on weight and body fat in men and women. *Obesity, 15*(6), 1496-1512.

Meigs, J.B. (2003). Epidemiology of cardiovascular complications in type 2 diabetes mellitus. *Acta Diabetologica*, 40, S358-S361.

Mian, O. S., Thom, J. M., Ardigo, L. P., Morse, C. I., Narici, M. V., & Minetti, A. E. (2007). Effect of a 12-month physical conditioning programme on the metabolic cost of walking in healthy older adults. *European Journal of Applied Physiology, 100*(5), 499-505.

Molanorouzi, K., Khoo, S., & Morris, T. (2015). Motives for adult participation in physical activity: Type of activity, age, and gender. *BMC Public Health, 15*, n/a.

Morey, M. C., Dubbert, P. M., Doyle, M. E., MacAller, H., Crowley, G. M., Kuchibhatla, M., et al. (2003). From supervised to unsupervised exercise: Factors associated with exercise adherence. *Journal of Aging and Physical Activity, 11*(3), 351-369.

Mortel, T.F. (2008). Faking it: Social desirability response bias in self-report research. *Australian Journal of Advanced Nursing (Online), 25*(4), 40-48.

Muir, J. M., Ye, C., Bhandari, M., Adachi, J. D., & Thabane, L. (2013). The effect of regular physical activity on bone mineral density in post-menopausal women aged 75 and over: A retrospective analysis from the canadian multicentre osteoporosis study. *BMC Musculoskeletal Disorders, 14*, n/a-253.

Nemoto, K., Gen-no, H., Masuki, S., Okazaki, K., & Nose, H. (2007). Effects of high-intensity interval walking training on physical fitness and blood pressure in middle-aged and older people. *Mayo Clinic Proceedings, 82*(7), 803-811.

Nguyen, H. M., & Cihlar, V. (2013). Differences in physical fitness and subjectively rated physical health in vietnamese and german older adults. *Journal of Cross-Cultural Gerontology, 28*(2), 181-194.

Nocon, M., Hiemann, T., Müller-Riemenschneider, F., Thalau, F., Roll, S., & Willich, S. N. (2008). Association of physical activity with all-cause and cardiovascular mortality: A systematic review and meta-analysis. *European Journal of Cardiovascular Prevention & Rehabilitation, 15*(3), 239-246.

O'Hagan, C., De Vito, G., & Boreham, C. A. (2013). Exercise prescription in the treatment of type 2 diabetes mellitus: Current practices, existing guidelines and future directions. *Sports Medicine (Auckland, N.Z.), 43*(1), 39-49.

Okada, S., Hiuge, A., Makino, H., Nagumo, A., Takaki, H., Konishi, H., et al. (2010). Effect of exercise intervention on endothelial function and incidence of cardiovascular disease in patients with type 2 diabetes. *Journal of Atherosclerosis and Thrombosis, 17*(8), 828-833.

Orueta, J. F., Garcia-Alvarez, A., Garcia-Goni, M., Paolucci, F., & Nuno-Solinis, R. (2014). Prevalence and costs of multimorbidity by deprivation levels in the basque country: A population based study using health administrative databases. *PloS One, 9*(2), e89787.

Palatini, P., Thijs, L., Staessen, J. A., Fagard, R. H., Bulpitt, C. J., Clement, D. L., et al. (2002). Predictive value of clinic and ambulatory heart rate for mortality in elderly subjects with systolic hypertension. *Archives of Internal Medicine, 162*(20), 2313.

Palatini, P. (2011). Role of elevated heart rate in the development of cardiovascular disease in hypertension. *Hypertension, 58*(5), 745-750.

Palatini, P. (2007). Heart rate as an independent risk factor for cardiovascular disease. *Drugs, 67*(2), 3-13.

Palazzo, C., Ravaud, J. F., Papelard, A., Ravaud, P., & Poiraudeau, S. (2014). The burden of musculoskeletal conditions. *PloS One, 9*(3), e90633.

Paoli, A., Pacelli, Q. F., Moro, T., Marcolin, G., Neri, M., Battaglia, G., et al. (2013). Effects of high-intensity circuit training, low-intensity circuit training and endurance training on blood pressure and lipoproteins in middle-aged overweight men. *Lipids in Health and Disease, 12*, 131-511X-12-131.

Park, S. K., Park, J. H., Kwon, Y. C., Kim, H. S., Yoon, M. S., & Park, H. T. (2003). The effect of combined aerobic and resistance exercise training on abdominal fat in obese middle-aged women. *Journal of Physiological Anthropology and Applied Human Science, 22*(3), 129-135.

Pedersen, B. K., & Saltin, B. (2006). Evidence for prescribing exercise as therapy in chronic disease. *Scandinavian Journal of Medicine & Science in Sports, 16 Suppl 1*, 3-63.

Perera, S., Mody, S. H., Woodman, R. C., & Studenski, S. A. (2006). Meaningful change and responsiveness in common physical performance measures in older adults. *Journal of the American Geriatrics Society, 54*(5), 743-749.

Perkins, J. M., Multhaup, K. S., Perkins, H. W., & Barton, C. (2008). Self-efficacy and participation in physical and social activity among older adults in Spain and the United States. *The Gerontologist, 48*(1), 51-58.

Pescatello, L.S., Franklin, B.A., Fagard, R. et al. (2004). American College of Sports Medicine position stand. Exercise and hypertension. *Medicine and Science in Sports and Exercise*, 36(3), 533-553.

Pigozzi, F., Rizzo, M., Giombini, A., Parisi, A., Fagnani, F., & Borrione, P. (2009). Bone mineral density and sport: Effect of physical activity. *Journal of Sports Medicine and Physical Fitness, 49*(2), 177-83.

Pischon, T., Boeing, H., Hoffmann, K., Bergmann, M., Schulze, M. B., Overvad, K., et al. (2008). General and abdominal adiposity and risk of death in europe. *The New England Journal of Medicine, 359*(20), 2105-2120.

Plotnikoff, R. C., Mayhew, A., Birkett, N., Loucaides, C. A., & Fodor, G. (2004). Age, gender, and urban-rural differences in the correlates of physical activity. *Preventive Medicine, 39*(6), 1115-1125.

Prados-Torres, A., Poblador-Plou, B., Calderon-Larranaga, A., Gimeno-Feliu, L. A., Gonzalez-Rubio, F., Poncel-Falco, A., et al. (2012). Multimorbidity patterns in primary care: Interactions among chronic diseases using factor analysis. *PloS One, 7*(2), e32190.

Rasekaba, T., Lee, A. L., Naughton, M. T., Williams, T. J., & Holland, A. E. (2009). The six-minute walk test: A useful metric for the cardiopulmonary patient. *Internal Medicine Journal, 39*(8), 495-501.

Reule, S., & Drawz, P. E. (2012). Heart rate and blood pressure: Any possible implications for management of hypertension? *Current Hypertension Reports, 14*(6), 478-484.

Rikli, R.E. and Jones, C.J. (2013). *Senior Fitness Test Manual*. 2nd ed. Champaign, IL: Human Kinetics.

Roberts, R. L. and Small, R. E. (2002). Cost of Treating Hypertension in the Elderly. *Current Hypertension Reports*, 4:420-423.

Roddy, E., Zhang, W., Doherty, M., Arden, N. K., Barlow, J., Birrell, F., et al. (2005). Evidence-based recommendations for the role of exercise in the management of osteoarthritis of the hip or knee-the MOVE consensus. *Rheumatology, 44*(1), 67.

Ross, R., & Bradshaw, A. J. (2009). The future of obesity reduction: Beyond weight loss. *Nature Reviews Endocrinology, 5*(6), 319-325.

Rossi, A., Dikareva, A., Bacon, S. L., & Daskalopoulou, S. S. (2012). The impact of physical activity on mortality in patients with high blood pressure: A systematic review. *Journal of Hypertension, 30*(7), 1277-1288.

Rubenstein, L. Z. (2006). Falls in older people: Epidemiology, risk factors and strategies for prevention. *Age and Ageing, 35*(suppl 2), ii37-ii41.

Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., and Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology*, 28, 335-354.

Sallis, J. F., Pinski, R. B., Grossman, R. M., Patterson, T. L., & Nader, P. R. (1988). The development of self-efficacy scales for health related diet and exercise behaviors. *Health Education Research, 3*(3), 283-292.

Santana, M. G., de Lira, C. A., Passos, G. S., Santos, C. A., Silva, A. H., Yoshida, C. H., et al. (2012). Is the six-minute walk test appropriate for detecting changes in cardiorespiratory fitness in healthy elderly men? *Journal of Science and Medicine in Sport / Sports Medicine Australia, 15*(3), 259-265.

Schafer, I., von Leitner, E. C., Schon, G., Koller, D., Hansen, H., Kolonko, T., et al. (2010). Multimorbidity patterns in the elderly: A new approach of disease clustering identifies complex interrelations between chronic conditions. *PloS One, 5*(12), e15941.

Schreuder, T. H., Maessen, M. F., Tack, C. J., Thijssen, D. H., & Hopman, M. T. (2014). Life-long physical activity restores metabolic and cardiovascular function in type 2 diabetes. *European Journal of Applied Physiology, 114*(3), 619-627.

Schwarz, P., Courteix, D. and Karlsson, M. (2006). Exercise and bone. *European Journal of Sport Science*, 6(3), 141-144.

Schwingshackl, L., Missbach, B., Dias, S., Konig, J., & Hoffmann, G. (2014). Impact of different training modalities on glycaemic control and blood lipids in patients with type 2 diabetes: A systematic review and network meta-analysis. *Diabetologia, 57*(9), 1789-1797.

Seidell, J. C. (2010). Waist circumference and waist/hip ratio in relation to all-cause mortality, cancer and sleep apnea. *European Journal of Clinical Nutrition, 64*(1), 35-41.

Semanik, P. A., Chang, R. W., & Dunlop, D. D. (2012). Aerobic activity in prevention and symptom control of osteoarthritis. *Pm&r, 4*(5, Supplement), S37-S44.

Semlitsch, T., Jeitler, K., Hemkens, L. G., Horvath, K., Nagele, E., Schuermann, C., et al. (2013). Increasing physical activity for the treatment of hypertension: A systematic review and meta-analysis. *Sports Medicine (Auckland, N.Z.), 43*(10), 1009-1023.

Shubert, T. (2011). Evidence-based exercise prescription for balance and falls prevention: A current review of the literature. *Journal of Geriatric Physical Therapy, 34*(3), 100-8.

Sigal, R. J., Kenny, G. P., Boulé, N. G., Wells, G. A., & et al. (2007). Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: A randomized trial. *Annals of Internal Medicine, 147*(6), 357-369.

Sigal, R. J., Kenny, G. P., Wasserman, D. H., Castaneda-Sceppa, C., & White, R. D. (2006). Physical Activity/Exercise and type 2 diabetes: A consensus statement from the American Diabetes Association. *Diabetes Care, 29*(6), 1433-8.

Skrypnik, D., Bogdanski, P., Madry, E., Karolkiewicz, J., Ratajczak, M., Krysciak, J., et al. (2015). Effects of endurance and endurance strength training on body composition and physical capacity in women with abdominal obesity. *Obesity Facts, 8*(3), 175-187.

Slentz, C. A., Duscha, B. D., Johnson, J. L., Ketchum, K., Aiken, L. B., Samsa, G. P., et al. (2004). Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE--a randomized controlled study. *Archives of Internal Medicine, 164*(1), 31-39.

Snowling, N. J., & Hopkins, W. G. (2006). Effects of different modes of exercise training on glucose control and risk factors for complications in type 2 diabetic patients: A meta-analysis. *Diabetes Care, 29*(11), 2518-2527.

Soroush, A., Der Ananian, C., Ainsworth, B. E., Belyea, M., Poortvliet, E., Swan, P. D., et al. (2013). Effects of a 6-month walking study on blood pressure and cardiorespiratory fitness in U.S. and swedish adults: ASUKI step study. *Asian Journal of Sports Medicine, 4*(2), 114-124.

Sousa, N., Mendes, R., Abrantes, C., Sampaio, J., & Oliveira, J. (2014). Effectiveness of combined exercise training to improve functional fitness in older adults: A randomized controlled trial. *Geriatrics & Gerontology International, 14*(4), 892-898.

Stathokostas, L., Theou, O., Little, R. M., Vandervoort, A. A., & Raina, P. (2013). Physical activity-related injuries in older adults: A scoping review. *Sports Medicine (Auckland, N.Z.), 43*(10), 955-963.

Stefanov, T., Vekova, A., Bonova, I., Tzvetkov, S., Kurktschiev, D., Bluher, M., et al. (2013). Effects of supervised vs non-supervised combined aerobic and resistance exercise programme on cardiometabolic risk factors. *Central European Journal of Public Health, 21*(1), 8-16.

Stensvold, D., Tjonna, A. E., Skaug, E. A., Aspenes, S., Stolen, T., Wisloff, U., et al. (2010). Strength training versus aerobic interval training to modify risk factors of metabolic syndrome. *Journal of Applied Physiology (Bethesda, Md.: 1985), 108*(4), 804-810.

Stevens-Lapsley, J. E., & Kohrt, W. M. (2010). Osteoarthritis in women: Effects of estrogen, obesity and physical activity. *Women's Health (London, England), 6*(4), 601-615.

Sugimoto, H., Demura, S., Nagasawa, Y. (2014). Age and Gender-Related Differences in Physical Functions of the Elderly Following One-Year Regular Exercise Therapy. *Health*, 6, 792-801.

Suri, P., Morgenroth, D. C., & Hunter, D. J. (2012). Epidemiology of osteoarthritis and associated comorbidities. *Pm&r, 4*(5, Supplement), S10-S19.

Swank, A. M., Funk, D. C., Durham, M. P., & Roberts, S. (2003). Adding weights to stretching exercise increases passive range of motion for healthy elderly. *Journal of Strength and Conditioning Research / National Strength & Conditioning Association, 17*(2), 374-378.

Sweet, S. N., & Fortier, M. S. (2010). Improving physical activity and dietary behaviours with single or multiple health behaviour interventions? A synthesis of meta-analyses and reviews. *Int. J. Environ. Res. Public Health*, 7, 1720-1743.

Swift, D. L., Lavie, C. J., Johannsen, N. M., Arena, R., Earnest, C. P., O'Keefe, J. H., et al. (2013). Physical activity, cardiorespiratory fitness, and exercise training in primary and secondary coronary prevention. *Circulation Journal: Official Journal of the Japanese Circulation Society, 77*(2), 281-292.

Terblanche, E., & Millen, A. M. (2012). The magnitude and duration of post-exercise hypotension after land and water exercises. *European Journal of Applied Physiology, 112*(12), 4111-4118.

Thomas, T. R., Warner, S. O., Dellsperger, K. C., Hinton, P. S., Whaley-Connell, A. T., Rector, R. S., et al. (2010). Exercise and the metabolic syndrome with weight regain. *Journal of Applied Physiology (Bethesda, Md.: 1985), 109*(1), 3-10.

Tokmakidis, S. P., Spassis, A. T., & Volaklis, K. A. (2008). Training, detraining and retraining effects after a water-based exercise program in patients with coronary artery disease. *Cardiology, 111*(4), 257-264.

Toraman, N. F., Erman, A., & Agyar, E. (2004). Effects of multicomponent training on functional fitness in older adults. *Journal of Aging and Physical Activity, 12*(4), 538-553.

Trujillo, K. M., Brougham, R. R., & Walsh, D. A. (2004). Age differences in reasons for exercising. *Current Psychology, 22*(4), 348-367.

Tu, W., Stump, T. E., Damush, T. M., & Clark, D. O. (2004). The effects of health and environment on exercise-class participation in older, urban women. *Journal of Aging and Physical Activity, 12*(4), 480-496.

Tuttle, L. J., Sinacore, D. R., Cade, W. T., & Mueller, M. J. (2011). Lower physical activity is associated with higher intermuscular adipose tissue in people with type 2 diabetes and peripheral neuropathy. *Physical Therapy, 91*(6), 923-930.

Villareal, D. T., Smith, G. I., Sinacore, D. R., Shah, K., & Mittendorfer, B. (2011). Regular multicomponent exercise increases physical fitness and muscle protein anabolism in frail, obese, older adults. *Obesity, 19*(2), 312-318.

Vincent, H. K., Heywood, K., Connelly, J., & Hurley, R. W. (2012). Obesity and weight loss in the treatment and prevention of osteoarthritis. *PM & R : The Journal of Injury, Function, and Rehabilitation, 4*(5 Suppl), S59-67.

Vinik, A. I., & Ziegler, D. (2007). Diabetic cardiovascular autonomic neuropathy. *Circulation, 115*(3), 387-397.

Warburton, D. E., Charlesworth, S., Ivey, A., Nettlefold, L., & Bredin, S. S. (2010). A systematic review of the evidence for canada's physical activity guidelines for adults. *International Journal of Behavioral Nutrition and Physical Activity, 7*, n/a-39.

Ware, J. E., & Kosinski, M. (2001). Interpreting SF&-36 summary health measures: A response. *Quality of Life Research, 10*(5), 405-13; discussion 415-20.

Weber Buchholz, S., Wilbur, J., Halloway, S., McDevitt, J. H., & Schoeny, M. E. (2013). Physical activity intervention studies and their relationship to body composition in healthy women. *Annual Review of Nursing Research, 31*, 71-142.

Westhoff, T. H., Franke, N. F., Schmidt, S. F., Vallbracht-Israng, K. F., Zidek, W. F., Dimeo, F. van der Giet, M. et al. (2007). Beta-blockers do not impair the cardiovascular benefits of endurance training in hypertensives. *Journal of Human Hypertension*, 21, 486-493.

Willis, L. H., Slentz, C. A., Bateman, L. A., Shields, A. T., Piner, L. W., Bales, C. W., Kraus, W. E. (2012). Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. *Journal of Applied Physiology*, 113(12), 1831–1837.

Wilmore, J.H. (2001). Dose-response: variation with age, sex, and health status. *Medical Science Sports Exercise,* 33 (suppl6), 622-634.

Winnicki, M., Bonso, E., Dorigatti, F., Longo, D., Zaetta, V., Mattarei, M., et al. (2006). Effect of body weight loss on blood pressure after 6 years of follow-up in stage 1 hypertension. *American Journal of Hypertension, 19*(11), 1103-1109.

Withrow, D., & Alter, D. (2011). The economic burden of obesity worldwide: A systematic review of the direct costs of obesity. *Obesity Reviews, 12*(2), 131-141.

Wolfe, F., Clauw, D. J., Fitzcharles, M. A., Goldenberg, D. L., Katz, R. S., Mease, P., et al. (2010). The american college of rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care & Research, 62*(5), 600-610.

Woo, J. S., Derleth, C., Stratton, J. R., & Levy, W. C. (2006). The influence of age, gender, and training on exercise efficiency. *Journal of the American College of Cardiology, 47*(5), 1049-1057.

Woolf, A. and Plfeger, B. (2003). *Burden of major musculoskeletal conditions.* Bulleting of the World Health Organization 81 (9). Geneva: World Health Organization.

World Health Organization (2008).*Waist circumference and waist-hip ratio: report of a WHO expert consultation*. Geneva: World Health Organization.

World Health Organization (2009). *Global health risks: mortality and burden of disease attributable to selected major risks.* Geneva: World Health Organization.

World Health Organization (2010). *Global recommendations on physical activity for health*. Geneva: World Health Organization.

World Health Organization (2011). *Global status report on non-communicable diseases 2010.* Geneva: World Health Organization.

Zhang, P., Zhang, X., Brown, J., Vistisen, D., Sicree, R., Shaw, J., et al. (2010). Global healthcare expenditure on diabetes for 2010 and 2030. *Diabetes Research and Clinical Practice, 87*(3), 293-301.

Zippenfening, H., & Sîrbu, E. (2014). Benefits of exercise on physical and mental health in rheumatoid arthritis patients. *Timisoara Physical Education and Rehabilitation Journal, 7*(13), 58-63.

APPENDICES

List of appendices

APPENDIX 1.

EXERCISE PRESCRIPTION

FOR DIFFERENT DISORDER GROUPS

Transtornos del aparato locomotor y ejercicio físico

Prescripción de ejercicio:

Tipo de ejercicio

Ejercicio aeróbico *(de larga duración y de moderada intensidad, con utilización de grandes grupos musculares, de tipo dinámico)*

La localización y la severidad de la afectación articular será determinante a la hora de elegir el tipo de ejercicio más adecuado en cada momento

Actividades en Carga *(caminar, correr suave, monte, bailar...)*

Actividades en Descarga *(nadar, bici... si existen alteraciones del aparato locomotor; por ejemplo, artrosis o problemas ortopédicos de EE.II)*

Actividades recomendadas *(aquellas de máximo beneficio con el mínimo riesgo)*

Calentamiento antes del ejercicio: *5-10 minutos de actividad moderada y ejercicios de movilidad articular, seguida de estiramientos*

Enfriamiento y vuelta a la calma *durante 5-10 minutos después del ejercicio*

Ejercicios en el agua

Frecuencia

Mínimo: 2 veces por semana (mantenimiento). Ideal: casi todos los días; 3-4 veces por semana, por ejemplo a días alternos

Duración

Sesiones 30 minutos a 2-3 horas, según el tipo de deporte y/o la situación personal. En una única sesión diaria, o bien 2-3 sesiones al día, de forma más fraccionada (según las posibilidades de cada uno)

Intensidad

Ejercicio aeróbico, siempre a baja/moderada intensidad; no interesa ni conviene realizar esfuerzos intensos (mayor riesgo de provocar lesiones y de tener complicaciones cardio-vasculares, peor tolerancia y mala aceptación del ejercicio)

Recomendaciones y Precauciones:

Calzado apropiado: *Calzado apropiado para el ejercicio, calzado deportivo!!! Elegir calzado y plantillas que atenúen el impacto. Utilizar ortesis para conseguir una corrección biomecánica (si fuera necesario)*

Alternancia de actividades con carga y sin carga del peso corporal a lo largo del día: *Es aconsejable alternar intervalos sucesivos de trabajo y reposo durante la sesión de ejercicio*

Vestimenta adecuada: *Ropa fresca y cómoda (que deje transpirar)!!! Sombrero, gorra...*

Hidratación suficiente: *Beber agua antes, durante y después de la AFD (siempre en función de las pérdidas por sudoración). No esperar a tener sed!!*

Protección articular: *Elegir actividades físicas de "bajo impacto", reducir la carga impuesta sobre la articulación afectada (por ejemplo, ejercicios en el agua, bici...). Evitar escaleras, saltos, paseos prolongados y en cuesta y carrera a pie en personas con problemas de artritis y/o artrosis en cadera o rodilla, o con problemas de apoyo plantar*

Seleccionar adecuadamente calzados y plantillas para conseguir la máxima atenuación y absorción del impacto durante las actividades de carga. Evaluar la necesidad de ortesis (plantillas) para la corrección biomecánica en tobillos y rodillas

Es recomendable que la persona aprenda una rutina de fortalecimiento muscular. Es fundamental que el ejercicio físico se convierta en un componente importante dentro de la rutina de la vida diaria. Si es necesario, se puede acumular más dosis de ejercicio en varias sesiones a lo largo del día

Normas de seguridad: El ejercicio de cierta intensidad está contraindicado en presencia de inflamación articular en fase aguda. El ejercicio físico no está indicado en presencia de dolor y/o inflamación.

*Si bien se puede esperar alguna molestia en partes blandas después del ejercicio, **se deben evitar aquellas actividades que causan un incremento del dolor articular durante más de una o dos horas después del ejercicio***

Control periódico del peso corporal: *Es conveniente pesarse cada 15 días en las mismas condiciones y circunstancias. Si aumenta el peso corporal, se realizará más "cantidad" de ejercicio!!!*

Servicios Médicos-Deportivos de Alava, SC

Hipertensión arterial y ejercicio físico

Prescripción de ejercicio:

Tipo de ejercicio

Ejercicio aeróbico *(de larga duración y de moderada intensidad, con utilización de grandes grupos musculares, de tipo dinámico)*

Actividad física en carga *(caminar, correr suave, monte, bailar...)*

Actividad física en descarga *(nadar, bici... si existen alteraciones del aparato locomotor; por ejemplo, artrosis o problemas ortopédicos de EE.II)*

Actividades recomendadas *(aquellas de máximo beneficio con el mínimo riesgo)*

Recomendaciones generales

Calentamiento antes del ejercicio: *5-10 minutos de actividad suave y ejercicios de movilidad articular, seguida de estiramientos*

Enfriamiento y vuelta a la calma *durante 5-10 minutos después del ejercicio*

Ejercicios en el agua

Frecuencia

Mínimo: 2 veces por semana (mantenimiento)

Ideal: casi todos los días; como media, 3-4 veces por semana; por ejemplo, a días alternos

Duración

30 minutos a 2-3 horas, según el tipo de deporte y/o la situación personal

En una única sesión diaria, o bien en 2-3 sesiones al día, de forma más fraccionada (según las posibilidades de cada uno).

Intensidad

Ejercicio aeróbico, siempre a baja-moderada intensidad; no interesa ni conviene realizar esfuerzos intensos (tienen mayor riesgo de complicaciones cardio-vasculares y de provocar lesiones, peor tolerancia y aceptación del ejercicio). ***El ejercicio a intensidad baja ó moderada parece reducir tanto o más la presión sanguínea de reposo que el ejercicio a intensidad más elevada, con menor riesgo***

Precauciones:

Control de la tensión arterial

Es necesario un control periódico de la tensión arterial, sobre todo antes del ejercicio (como mínimo, una vez al mes; preferiblemente, cada 15 días). Para no correr riesgos con el ejercicio, se deben respetar rigurosamente los criterios médicos y las normas de seguridad!

Normas de seguridad:

El ejercicio físico no está indicado cuando la presión arterial sistólica (la "alta") de reposo es superior a 200 mmHg, o bien la presión diastólica (la "baja") supera los 115 mmHg. Además, se retrasará provisionalmente el ejercicio si la presión arterial sistólica es superior a 180 mmHg y la presión arterial diastólica supera 110 mmHg

Control periódico del peso corporal

Se recomienda pesarse cada 15 días en las mismas condiciones y circunstancias. Si aumenta el peso corporal, se debe realizar más "cantidad" de ejercicio!!!

Régimen dietético y/o medicación

El ejercicio físico es mejor tolerado con un adecuado control de la HTA mediante modificaciones en el estilo de vida y, si es necesario, medicación anti-hipertensiva

Es muy importante respetar una adecuada relación horaria entre la ingesta y la AFD: la toma de alimentos debe realizarse de 1 a 3 horas antes del ejercicio, según el tipo y la cantidad de comida realizada

Diabetes, Obesidad y ejercicio físico

Prescripción de ejercicio:

Tipo de ejercicio

Ejercicio aeróbico *(de larga duración y de moderada intensidad, con utilización de grandes grupos musculares, de tipo dinámico)*

Actividad física en carga *(caminar, monte, footing...)*

Actividad física en descarga *(nadar, bici... si transtornos del aparato locomotor)*

Actividades recomendadas *(aquellas de máximo beneficio con el mínimo riesgo)*

Calentamiento antes del ejercicio: *5-10 minutos de actividad suave seguida de stretching (estiramientos)*

Enfriamiento y vuelta a la calma *durante 5-10 minutos después del ejercicio*

Ejercicios en el agua

Frecuencia

Mínimo: 2 veces por semana. Ideal: casi todos los días; 3-4 veces por semana; por ejemplo a días alternos

Duración

30 minutos a 2-3 horas, según el tipo de ejercicio y/o la situación personal. En una única sesión, o bien 2-3 sesiones al día, de forma más fraccionada

Intensidad

Ejercicio aeróbico siempre de baja a moderada intensidad, no interesa ni conviene realizar esfuerzos intensos

Precauciones:

Calzado apropiado y vestimenta adecuada

Calzado apropiado para el ejercicio, calzado deportivo!!! Atención a los pies!!! Posibilidad de neuropatía periférica (incrementa el peligro de daño o lesión de los pies; en general, un calzado apropiado puede aportar suficiente protección pero, si es severa, debe evitarse el ejercicio en carga; en estos casos, la natación o la bici son actividades físicas adecuadas)

Utilizar ropa fresca y cómoda (que deje transpirar)!!! Sombrero, gorra,... Posibilidad de neuropatía autonómica (riesgo más elevado de eventos cardiovasculares adversos durante el ejercicio; la hipotensión ortostática es común. La bicicleta y la natación son más apropiadas que la carrera. También puede provocar alteraciones de la termo-regulación, por lo que se debe evitar el ejercicio en ambientes extremos de frío o calor y prevenir siempre el riesgo de deshidratación)

Hidratación suficiente

Beber agua antes, durante y después del ejercicio y/o actividad física (siempre en función de las pérdidas por sudoración). No esperar a tener sed!! Beber agua a intervalos regulares

Monitorización de la glucemia

Determinar la glucemia antes, durante y después del ejercicio. Administrar insulina al menos una hora antes del inicio del ejercicio. Como precaución, disminuir la dosis de insulina previa al ejercicio.

Retrasar el ejercicio si la glucemia es superior a 250 mg/dl y es positiva la determinación de cuerpos cetónicos en orina. Evitar el ejercicio si los niveles de glucosa exceden de 300 mg/dl (o 250 mg/dl con cetosis). *El ejercicio físico empeora el control de la glucemia si no hay suficiente insulina;* ***no practicar deporte con hiperglucemia y/o cuerpos cetónicos!!! Tomar un "extra" de carbohidratos antes del ejercicio si los niveles de glucosa en sangre caen por debajo de 100 mg/dl. El riesgo potencial más inmediato y peligroso del ejercicio es la hipoglucemia (nivel de glucosa en sangre por debajo de 65 mg/dl) El ejercicio físico puede descender la glucemia, pudiendo provocar hipoglucemia;*** *debemos disminuir la dosis de insulina y/o aumentar la ingesta de alimentos suplementarios (carbohidratos), según el horario, el tipo de ejercicio y el tipo de diabetes. No olvidar nunca* ***llevar azúcar o carbohidratos de absorción rápida para tratar inmediatamente posibles hipoglucemias***

Control periódico del peso corporal

Pesarse cada 15 días en las mismas condiciones y circunstancias. Si aumenta el peso corporal, realizar más "cantidad" de ejercicio!!!

Régimen dietético y/o medicación

El ejercicio físico mejora la glucemia siempre que se trate de un diabético bien controlado (dieta y medicación). *Las comidas deben hacerse 1 a 3 horas antes del ejercicio. Se puede aumentar la ingesta de comida (carbohidratos) después del ejercicio, dependiendo de la intensidad del mismo. No olvidar que el ejercicio consume calorías, disminuye la hiperglucemia y puede reducir las necesidades de medicación, de modo que* ***debe ir ajustado a la dieta y a la medicación.***

APPENDIX 2.

STRUCTURE OF EXERCISE SESSIONS

FOR DIFFERENT DISORDER GROUPS

PROGRAMA DE RECUPERACIÓN DE PATOLOGÍAS

	DURACIÓN	CONTENIDOS	OBJETIVOS	INT / FREC / DUR	TIEMPO
CALENTAMIENTO	10' - 15'	Estiramientos Movilidad articular	Preparación al ejercicio Prevención de lesiones	Suave Gradual Progresivo	3 - 6 meses 9- 12 meses
	DURACIÓN	CONTENIDOS	OBJETIVOS	INT / FREC / DUR	TIEMPO
EJERCICIO	30' - 45'	Flexibilidad	a) Mantener y/o ganar rango de movilidad. b) Mejorar marcha, equilibrio y coordinación. c) Disminuir la rigidez.		3 - 6 meses 9- 12 meses
		Fuerza muscular	a) Aumentar la fuerza. b) Aumentar el nº máximo de repeticiones. c) Mejorar contracción máxima	Muchas repeticiones, baja reistencia, según tolerancia.	
		Aeróbico	a) Aumentar el V O_2 max y umbral ventilatorio. b) Aumentar el trabajo máximo y resistencia cardiorespiratoria. c) Aumentar el gasto calórico. d) Control de TA	50 - 90% FC máxima 3 días / semana 30' - 60' /sesión	
		Recuperación funcional (específico)	a) Mejorar la capacidad funcional para las actividades de la vida diaria. b) Aumentar la autoconfianza. c) Retorno al trabajo d) Mejorar la calidad de vida	En función del límite del dolor, tolerancia y situación individual.	
	DURACIÓN	CONTENIDOS	OBJETIVOS	INT / FREC / DUR	TIEMPO
ENFRIAMIENTO	5' - 10'	Recuperación activa. Estiramientos. Relajación	a) Mejorar la recuperación. b) Vuelta progresiva a la calma.	Progresivamente decreciente.	3 - 6 meses 9- 12 meses

ARTRITIS

TIPO DE TRABAJO	OBJETIVO	METODO	TIEMPO
AEROBICO GRANDES GRUPOS MUSCULARES (ANDAR, NADAR, REMAR, BICICLETA, DANZA, EJERCICIOS EN EL AGUA)	AUMENTAR CONSUMO DE OXIGENO AUMENTAR RESISTENCIA AUMENTAR TRABAJO MAXIMO	60-80 % FC máx. 40-60 % VO2 máx. 3 DIAS/SEMANA VOLUMEN	4-6 MESES
FUERZA CIRCUITOS PESOS LIBRES MAQUINAS ISOMETRICOS, GOMAS	MEJORAR CONTRACCION MAXIMA Y POTENCIA	TOLERANCIA AL DOLOR 2-3 REP. HASTA 10-12 2-3 SESIONES/SEMANA	
FLEXIBILIDAD ESTIRAMIENTOS	MANTENER/AUMENTAR RANGO DE MOVILIDAD DISMINUIR RIGIDEZ	1-2 SESIONES/SEMANA	
NEUROMUSCULAR	MEJORAR LA MARCHA Y EL EQUILIBRIO		
FUNCIONAL EJERCICIOS ESPECIFICOS DE ACTIVIDAD	AUMENTAR ACTIVIDADES DE LA VIDA DIARIA RETORNO AL TRABAJO MEJORAR LA CALIDAD DE VIDA		

HIPERTENSION

TIPO DE TRABAJO	OBJETIVO	METODO	TIEMPO
AEROBICO GRANDES GRUPOS MUSCULARES	Aumentar VO2 máx. Aumentar UMBRAL VENTILATORIO Aumentar TRABAJO MAXIMO Aumentar RESISTENCIA Aumentar GASTO CALORICO Control TENSION ARTERIAL	50-85 % FC máx. 3 DIAS/SEMANA 30-60'/SESION	
FUERZA CIRCUITOS	Aumentar FUERZA	MUCHAS REPETICIONES CARGA/RESISTENCIA BAJA	

DIABETES

TIPO DE TRABAJO	OBJETIVO	METODO	TIEMPO
AEROBICO GRANDES GRUPOS MUSCULARES	AUMENTAR CAPACIDAD AEROBICA AUMENTAR TIEMPO DE TRABAJO AUMENTAR CAPACIDAD DE TRABAJO MEJORAR RESPUESTA DE T. ARTERIAL AL EJERCICIO REDUCIR FACTORES DE RIESGO CARDIOVASCULAR	50-90 % FC máx. 50-85 % VO2 máx. 3 DIAS/SEMANA 60' POR SESION	4-6 MESES
FUERZA PESOS LIBRES MAQUINAS INTERVAL	AUMENTAR NUMERO MAXIMO DE REPETICIONES		4-6 MESES
FLEXIBILIDAD	MANTENER/GANAR RANGO DE MOVILIDAD MEJORAR LA MARCHA, EQUILIBRIO Y COORDINACION		4-6 MESES
FUNCIONAL EJERCICIOS ESPECIFICOS MANEJO DE PESOS	AUMENTAR ACTIVIDADES DE LA VIDA DIARIA AUMENTAR LA CONFIANZA EN SI MISMOS		

OBESIDAD

Programación del ejercicio

Tipo	Objetivos	Int/Frec/Dur	Tiempo
Aeróbico *Actividades que implican grandes grupos musculares* *(p.e, caminar, remo, ciclismo, natación,...)*	*Reducir el peso* *Mejorar el rendimiento* *Reducir el riesgo*	*50-70% VO2 max* *Monitorizar RPE y FC* *5 dias/semana* *40-60 minutos por sesión* *(o 2 sesiones/dia de 20-30 min)* *Insistir más en aumentar la duración que sobre la intensidad*	*9-12 meses*
Flexibilidad			
Stretching	*Incrementar el rango de movilidad*	*Diariamente o, al menos 5 sesiones/semana*	
Funcional			
Ejercicios Específicos	*Facilitar el desarrollo de las actividades diarias* *Aumento de la autoconfianza y de la autonomía*		

APPENDIX 3.

SATISFACTION AND MOTIVATION QUESTIONNAIRES

PROGRAMA DE INTERVENCION EN PERSONAS AFECTADAS POR PATOLOGIAS CRONICAS

TRIMESTRE: ☐ ☐☐ Nº PACIENTE: ☐☐☐☐

SATISFACCIÓN PERSONAL

1º ¿Te sientes mejor contigo mismo desde que realizas ejercicio? ☐ NO ☐ SI

2º ¿Te encuentras más capacitado para realizar las tareas de la vida cotidiana desde que has empezado el programa? ☐ NO ☐ SI

3º ¿Crees que vas consiguiendo pequeños logros que con el tiempo te harán sentir mejor y controlar adecuadamente tu enfermedad? ☐ NO ☐ SI

4º Esos logros, ¿son mayores de lo que tú te imaginabas?

5º ¿Te da la impresión de estar en un programa seguro?

Control por profesionales Sanitarios ☐ NO ☐ SI

Control por profesionales de la Educación Física ☐ NO ☐ SI

6º ¿Estás satisfecho respecto a la atención personal que se te presta? ☐ NO ☐ SI

VALORACIÓN: (Nº de respuestas afirmativas)

0-2: BAJA
3-4: MEDIA
5-6: ALTA

TRIMESTRE: ☐ ☐☐ Nº PACIENTE: ☐☐☐☐

MOTIVACIÓN

1º ¿Te gusta hacer ejercicio? ☐ NO ☐ SI

2º ¿Te resulta agradable el ambiente en el que desarrollas tu actividad física?

Compañeros ☐ NO ☐ SI

Monitores ☐ NO ☐ SI

Instalaciones deportivas ☐ NO ☐ SI

3º ¿Te sientes capaz de mejorar? ☐ NO ☐ SI

4º ¿Te anima tu familia o amigos a continuar? ☐ NO ☐ SI

5º Cuando estás en casa, ¿te apetece ir al Programa Terapéutico aunque alguna vez te dé algo de pereza? ☐ NO ☐ SI

6º ¿Crees realmente que todo esto va a servir de algo? ☐ NO ☐ SI

VALORACIÓN: 0-2: BAJA
(Nº de respuestas afirmativas) 3-4: MEDIA
5-6: ALTA