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The Influence of Physical Activity Behaviour of Public Fitness Centre Members on Cardiovascular Disease Risk Factors

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The Influence of Physical Activity Behaviour of Public Fitness Centre Members on Cardiovascular Disease Risk Factors

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In partnership with GO fit, Ingesport and UK Active

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Certificate of Ethical Approval

Applicant:

Brett Staniland

Project Title:

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This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

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Declaration

The work submitted in this thesis has been undertaken during my time of registration. I declare that all work submitted is my own, conducted by myself, with assistance where acknowledged, and has not been submitted previously as part of other applications.

Acknowledgments

I would like to thank several people who have helped me complete this thesis. Firstly, my supervisory team for their continued support throughout this PhD project; Alfonso Jimenez for initially selecting me for this project, and Gordon McGregor for his valuable input in writing this thesis. In particular, I would like to acknowledge the great support from my director of studies, Dr Elizabeth Horton and for taking me on as a PhD student half way through my journey. Thank you to other academics not directly involved with my project; Professor Derek Renshaw from Coventry University, Dr James Steele from UK Active and Dr Gary Liguori from University of Rhode Island for their support and guidance throughout the last few years. All of which have contributed to improving my academic writing and research skills.

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Abstract

Background

Cardiovascular disease (CVD) is the number one cause of death globally, affecting people of all ages. Many of these deaths are preventable as they are attributed to lifestyle risk factors such as smoking, diet and lack of physical activity (PA). Countries throughout Europe have reported a rise in physical inactivity and the prevalence of CVD risk factors, contributing to a rise in the number of deaths attributed to CVD. Spain in particular has witnessed an increase in deaths due to CVD, becoming one of the most physically inactive nations in the European Union. Reports from Spain outline an increase in economic spending aimed at treating CVD, as a consequence of elevated risk profiles from poor lifestyle behaviours. Public health initiatives including exercise interventions have aimed to improve CVD risk factors such as cholesterol, blood glucose, blood pressure and body composition, amongst others, to improve the CVD risk profile and overall health status. To inform initiatives aimed at improving PA levels, we rely on research to dictate the most appropriate and effective interventions for increasing PA and exercise and decreasing sedentariness and inactivity. Public fitness centres have been called upon to be the “hub” for increasing PA levels and creating active communities. Public fitness centre members are an under-used population in the literature, yet represent an ideal demographic for assessing public and community-based settings for PA. However, there is little known about members’ overall PA levels, the predictors of PA, and whether different PA approaches provide a beneficial impact on the CVD health profile of members. There is also a paucity of evidence concerning the effectiveness of type of PA undertaken by fitness centre members. Previous reports have shown combined aerobic exercise and resistance training are more effective at reducing multiple risk factors than aerobic exercise alone and hence international PA guidelines and advice often include this. However, a large body of research has focused on exercise interventions within laboratory settings and using supervised exercise programmes which may not truly reflect exercising behaviour in real-world environments. Therefore, the aim of this thesis was to investigate PA behaviour of fitness centre members, in comparison to PA behaviour of the general population, determine the predictors of greater PA levels and investigate which PA behaviour provides greater benefits to CVD risk factors; unstructured free roam exercise or a structured combined exercise programme.

Chapter 3: Systematic Review

An original review of literature (chapter 2) provided the rationale for chapter 3. Twenty studies, set in community-based settings investigating exercise on CVD risk factors, were included for review. Studies reported small sample sizes and mostly combined exercise programmes of AE and RT. Baseline risk profiles were elevated for most samples, and those which showed the greatest change in risk factors tended to have the most elevated risk factors. Interventions were mostly short in duration and varied in intensity. The training volume appeared to have the greatest impact on risk factors, and is supported by previous reviews, though further studies are required to substantiate this.

Chapter 4: Comparative Analysis of Public Fitness Centre Members

Self-reported PA, directly-measured fitness centre engagement and demographic data was obtained from a large scale survey of 12,371 public fitness centre members and compared with data from the Eurobarometer for Sport & Physical Activity for descriptive analysis. Fitness centre members were highly physically active (Mean PA from IPAQ = 3847.47 ± 2803.77 MET.Mins.Wk^{-1}) and significantly more active than the general population of Spain and Europe following a truncation method of IPAQ results (Mean truncated PA: Fitness centre members = 3099.78 ± 2204.69 MET.Mins.Wk^{-1}; Spain = 2537.19 ± 2414.19 MET.Mins.Wk^{-1}; EU28 = 2355.61 ± 2331.19 MET.Mins.Wk^{-1}, $p<0.001$). These results may have significance regarding reduced CVD risk as a result of the difference in PA levels between these populations.

Chapter 5: Predictors of Behaviour in PA in Public Fitness Centre Members

Independent and multivariate regression analyses were undertaken on the secondary data (used in chapter 4) from fitness centre members to investigate predictors of PA and fitness centre engagement. The regression model predicted PA; $F(6, 3689) = 69.553$, $p<0.001$, $R^2 = 0.1$, consisting of 6 predictors: number of fitness centre visits, age, sex, visit duration, education level and civil status. Socioeconomic variables such as higher education level and greater income, intrinsic motives, being male and attending more group exercise classes were significant predictors of fitness centre engagement.

Chapter 6: The Effects of Usual Exercise Behaviours and Structured Exercise at Improving Health Outcomes in Inactive Public Fitness Centre Members

The fourth study was a randomised pilot trial in a Spanish public fitness centre. Fitness centre members who were physically inactive and had not attended the centre for at least 60 days, were randomly assigned to one of three groups. One group performed a 12-week programme of structured combined exercise based on the ACSM exercise recommendations (COMB, n=15), compared with a free-roam group (FREE, n=6) with access to facilities but no structured programme, and a non-exercising control group instructed to continue their usual behaviour (CON, n=9). None of the groups were instructed to change their diet. Measurements for body composition, blood pressure, cholesterol, triglycerides, glucose and VO_2max were obtained pre- and post-intervention. Estimated marginal means and 95% confidence intervals showed a significant within-group change in the COMB group for change in Muscle Mass: +1.26kg (0.74 to 1.78kg), Body Mass Index: +0.03 (–0.34 to –0.39kg/m^2), Body Fat: –1.33 (–2.2 to –0.46kg), Body Fat %: –1.7% (–2.49 to –0.93%) and Waist:Hip ratio: –0.025 (–0.039 to –0.012), Diastolic blood pressure: –4.3mmHg (79.9 to 75.6mmHg) and Cholesterol: –27mg/dL (225 to 198mg/dL). Cholesterol was also reduced in the FREE group: –29mg/dL (209 to 180mg/dL). Structured, combined exercise improved risk factors the most overall however, the free-roam group also produced positive effects to total cholesterol levels.

Fitness centre members are significantly more active than the general population, which potentially reduces their risk of CVD. Higher education level, employment status, sex (being male) and intrinsically-derived motives (keep fit and feel good), were predictors of increased PA behaviour within fitness centre members. Further predictors of PA are related to engagement with the fitness centre such as attending more group exercise classes. The data indicate which people are most likely to achieve greater PA levels as well those who are likely to sustain long-term active lifestyles (those with higher socioeconomic profiles, attend the fitness centres more often and attend group exercise classes and are intrinsically motivated). This information can be used by fitness centres to address possible membership drop-out and non-completion of exercise interventions. Free roam (self-selected) exercise potentially improved CVD risk, though was perhaps not as effective when compared to structured exercise. Larger-scale studies in this population are necessary to explore findings further. The studies in this thesis showed that investigations set in community-based settings are important at understanding PA behaviour of fitness centre members compared with the general population. Whilst self-report data has its limitations, this project showed that methods combining self-report and objectively assessed PA, can provide a better understanding of PA behaviour. This project provides novel insight into the PA behaviour of fitness centre members, utilises a very large sample which has not previously been used in this area of literature and supports the claims that fitness centres have an important role in creating active communities.

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Publications

Conference Presentations

Staniland, B., Lopez-Fernandez, J., Sanchez, I., Iturriaga, T., Ayuso, M., Horton, E., Atkinson, L., Mann, S., Liguori, G. and Jimenez, A., 2018. Effects Of A 12-week Structured Exercise Intervention On Cholesterol. *Medicine & Science in Sports & Exercise*, *50*(5S), p.54.

Abbreviations

<	less than
≤	less than or equal to
>	more than
≥	more than or equal to
%	Percent or Percentage
1RM	1 Repetition Maximum
ACSM	American College of Sports Medicine
ADP	Adiponectin
ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
APP	Application (Mobile)
AQoL	Assessment for Quality of Life
BF%	Body Fat Percentage
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
Bn	Billion
BP	Blood Pressure
CI	Confidence Intervals
COM-B	Capability, Opportunity and Motivation - Behaviour System
COMB	Combined Exercise Group
CONT	Control Group
CRP	C-Reactive Protein
CVD	Cardiovascular Disease
CVRF	Cardiovascular Risk Factors
DBP	Diastolic Blood Pressure
et al.	Et Alii (and others)

EU	European Union
EU28	European Union 28 member states (Pre-Brexit)
EU15	European Union 15 original member states (Pre-Brexit)
FC	Frequencia Cardiaca (Heart Rate, Spanish)
FREE	Free roam of Gym Group
GLUC	Mean Fasting Blood Glucose
HDL-C	High-Density Lipoprotein Cholesterol
1HIIT	High-Intensity Interval Training
HMG CoA	3-hydroxy-3-methyl-glutaryl-coenzyme A
HR	Heart Rate
HRA	Health Risk Appraisal
HRR	Heart Rate Reserve
HbA_{1c}	Glycated Haemoglobin
IPAQ	International Physical Activity Questionnaire
IL-6	Interleukin 6
KmH	Kilometres per Hour
L	Leptin
LAB	Laboratory
LBM	Lean Body Mass
LDL-C	Low-Density Lipoprotein Cholesterol
M	Mean
m	Million
MAP	Mean Arterial Pressure
MET	Metabolic Equivalent
$MET.Mins.Wk^{-1}$	Metabolic Equivalent Minutes per Week
mg/dL	Milligram per decilitre
MICT	Moderate Intensity Continuous Training

ml/kg/min	Millilitre per Kilogram per Minute
mmHg	Millimetre of mercury
mmol/L	millimole per litre
NHS	National Health Service
PA	Physical Activity
PAI	Plasminogen Activator Alpha
PIA	Physical Inactivity
PARQ	Physical Activity Readiness Questionnaire
PhD	Doctor of Philosophy
Pr	Pulse Rate
RM	Maximal Repetitions
RPE	Rate of Perceived Exertion
SBP	Systolic Blood Pressure
SPSS	Statistical Product and Service Solutions
SD	Standard Deviation
TNF	Tumor Necrosis Factor
VO_2	Oxygen Consumption
VO_2max	Maximal Oxygen Consumption
WC	Waist Circumference
WHO	World Health Organisation
W:H	Waist to Hip Ratio
Yr	Year

Chapter 1. Introduction

This chapter introduces the overall project as well as its' rationale, aims and objectives. It outlines my role within the research project and the structure of the thesis.

1.1. Study Context

Year on year, mortality due to CVD is growing (Timmis et al., 2020). This is both a public health and economic concern. The prevalence of lifestyle risk factors which are preventable, has increased over previous years throughout Europe. A lack of physical activity is one particularly prevalent risk factor which is linked to mortality and significant costs in treating disease linked with physical inactivity. Spain has recently reported growing trends of physical inactivity and increasing healthcare costs of treating CVD (Sánchez-Oliver et al., 2018). Reports and investigations have focused on these issues within the general populations but not to the same extent within members of public fitness centres.

GO fit are a large provider of public fitness centres in Spain, providing low-cost and high-quality centres (family membership for four people is €81, approximately £73, per month). The centres offer a range of services including, water-based activities, fitness rooms, group exercise classes, indoor and outdoor sports, as well as nutritionists, physiotherapists and mind & body activities. The membership of each fitness centre ranges from 15-40,000 members, with a total of 205,000 members across its Spanish centres, the highest in the market (Herman et al., 2019). Centers are situated 15 in mainland Spain; six centrally, three in the north and six in the south (Figure 1). The focus of the thesis project is on Spain, Spanish fitness centre members and the context of this with the UK and Europe for reference.

Within the fitness centre at Vallehermoso, Madrid, is the GO fit LAB (located at the cluster of 6 centres, figure 1), a research facility where GO fit aims to produce evidence-based exercise options for their members. Within the GO fit LAB, is the research team employed by GO fit and post-graduate students from university partners. The LAB contains equipment for testing procedures, such as a treadmill, gas analyser, body composition analysis machine, and blood analysis. The GO fit LAB in

Madrid was the central hub for my research project and where the collaborative work between Coventry University and GO fit took place.

Figure 1: Locations and number of Public Fitness Centres in each region of Spain. Borders are the Spanish Autonomous communities. Grey territory on the left is Portugal (www.GO fit.es).

1.2. Study Rationale

There is clear and substantial evidence of the effectiveness of PA and exercise in reducing the risk of CVD (Shiroma and Lee, 2010). However, the majority of this evidence comes from controlled, laboratory studies. What is less clear from the evidence is whether these benefits can be attained in real life settings. Whilst the findings reported from laboratory-based studies may indicate efficacy, their effectiveness may be questioned when trying to impact the health of a large community or the public in settings outside of this environment. Very few studies have performed investigations in large populations or have been undertaken in Spain, aimed at understanding exercise behaviour. Studies have investigated the difference in PA behaviour with reference to the COVID-19 pandemic showing a significant decrease during the Spanish quarantine (López-Sánchez et al., 2021, Sánchez-Sánchez et al., 2020). In other studies, due to methodological inconsistencies and limited samples, representation of the general population is not possible making comparisons scarce (Mielgo-Ayuso et al., 2016). Further, predictors of PA behaviour in studies do not include PA behaviours such as how often and what PA do highly active individuals perform or what motivates them. A study by Gjestvang et al. (2020a) investigated the motives of regular exercisers in fitness club members reporting enjoyment and challenge as key motives although this studied just one fitness club chain, and had limitations surrounding the self-report data as well as defining exercise as “regular” does not indicate their compliance with PA guidelines.

Public fitness centres provide an environment for large numbers of people to engage in exercise; over five million members currently exercise in fitness centres in Spain. A paucity of research has been reported on the PA of fitness centre members. Gjestvang et al. (2020b), investigated the likeliness fitness club members would achieve PA guidelines reporting more than half the members being insufficiently physically active. Although, this study is limited to using one centre in Norway and contained a small sample size of mostly white Norwegian individuals with high socioeconomic status. Not much is known about the activity behaviour of public fitness centre members compared to the general population though a recent study reported a higher prevalence of achieving high PA. Further, whether their physical activity behaviour improves the CVD risk profile is yet to be investigated.

This project investigates a population of fitness centre members in Spain, helping to understand their overall PA levels and engagement with fitness centres, and the potential impact this may have with regards to improving CVD risk. Physically inactive individuals have an increased risk of CVD and contribute greatly to the healthcare and economic burden of treating CVD and have a lowered healthy life expectancy. This project provides insight into engaging inactive adults in exercise, who it has been shown many have fitness centre membership, comparing various exercise options in real-world settings. Members of fitness centres perform a wide range of activities including exercise classes, gym and swimming, but there is a paucity of research comparing these exercise behaviours with structured exercise programmes such as resistance and aerobic exercise training. During the previous few years, fitness centre membership has become increasingly accessible, with the growth of the industry, more centres opening, and cheaper options becoming available. Therefore, with physical inactivity increasing, more investigation into the predictors of greater physical activity is required, to understand this situation.

1.3. Aims and Objectives

The aim of this thesis is to understand exercise behaviour of centre members and its influence on CVD risk factors. Key objectives are to evaluate current physical activity levels in Spanish fitness centre members, compared with the general populations of Spain and Europe, investigate the predictors of achieving greater PA levels, understand the various motives for exercise, and investigate whether structured exercise recommendations improve CVD risk factors more than the general exercising behaviour of fitness centre members.

1.4. Structure of the Thesis

This thesis consists of seven main chapters; including four experimental chapters. Following this introduction, the second chapter provides background knowledge on CVD and PA, defines key terms, and current PA situations in Europe. Chapter three is a systematic literature review of studies using community-based exercise interventions. Following this, chapter four is a descriptive analysis of PA behaviour using a large survey of questions to members of public fitness centres, comparing PA behaviour of the general population with public fitness centres using publicly-accessible secondary data. Chapter five investigates the predictors of PA behaviour within fitness centre members. The final experimental chapter is a randomised controlled pilot trial, in a public fitness centre, comparing a 12-week structured combined exercise intervention with a free roam exercising group, and a non-exercising control group in inactive fitness centre members. The final chapter discuss the findings of the thesis in a more general perspective, understanding the place, contribution, limitations and recommendations of the thesis.

1.5. My role within the research project

The work within this thesis is my own. The project contained within the thesis is a collaboration between Coventry University and Ingesport, owner of GO fit, a provider of public fitness centres in Spain. Within the flagship centre in Vallehermoso, Madrid, is the GO fit LAB which is described in more detail in the following sections. With regards to the project contained in this thesis, the survey described in chapters four and five, was administered and completed by the marketing department and an external company; ShopperTec (http://shoppertec.com Registro Mercantil de Madrid Tomo 27656, folio 149, Inscripción 1, Hoja m-498359). Therefore, the data obtained by me is secondary data. However, the research questions in thesis are my own original work. I was responsible for the cleaning and handling of the data as well as the analysis presented in each chapter and the design of the studies contained in this thesis. The data in chapter six is primary data, this was collected by me with the help of the research team in the GO fit LAB.

All studies were approved by the Coventry University Ethics committee (References: P60826 & P94520) and conformed to the declaration of Helsinki (Appendix 9.1). All participants provided informed consent in the nature of electronic tick-box for the online surveys, and a hand-written signature for the pilot trial in chapter six, after reading a specific participant information sheet (Appendix 9.3).

Chapter 2. Literature Review

2.1. Introduction

This chapter introduces the literature on cardiovascular disease (CVD), and its impact in Europe and more specifically, Spain (Section 2.9). The burden of CVD and insufficient physical activity is examined, both for the individual and the economy. Section 2.10 outlines preventable risk factors and lifestyle changes, with a focus on outlining the use of physical activity (PA), in decreasing the risk of CVD. The relationship between PA and health is further explored in the latter sections of this chapter. The prevalence and barriers of PA is discussed and finally increasing PA levels through exercise, aimed at improving CVD risk factors is critically reviewed.

2.2. Cardiovascular Disease

The following sections define CVD and the associated risk factors. Aetiology and pathophysiology are outlined, and the incidence of CVD is described across Europe and in Spain, the location of the research project. Sections 2.10 explores each modifiable risk factor of CVD, how these are measured, and treatment options.

2.2.1. Definition and Aetiology of CVD

CVD is a classification of multiple diseases affecting the heart and blood vessels. It includes strokes, coronary artery disease and hypertensive heart disease (Lopez and Jan, 2019). Risk factors such as hypertension, hyperlipidaemia, high cholesterol and diabetes put one at an increased risk of CVD. Further, preventable risk factors caused by lifestyle and behavioural choices include smoking, obesity and physical inactivity (Levenson et al., 2002, Yusuf et al., 2004).

2.2.2. Incidence of CVD

The World Health Organisation (WHO) reported that CVD accounted for an estimated 17.8m deaths worldwide in 2019, making it the number one cause of death (Kaptoge et al., 2019). The incidence of CVD throughout Europe has continually increased over the previous 25 years (Timmis et al., 2017), with a dramatic increase particularly in the last ten years (Figure 2). In the UK the number of people living with CVD rose from 7.4 million to 7.6 million between 2020 and 2021 (British Heart Foundation, 2021). Estimates suggest that in Europe, CVD is responsible for approximately 3.9 million deaths per annum, a contribution of 45% of total deaths (Spiteri and von Brockdorff, 2019). It is predicted that this number will continue to rise over the next few years (WHO, 2020a). In a report produced by the European Society of Cardiology (ESC) (Timmis et al., 2020), CVD is indicated as the most common cause of premature death for males in ESC member countries, and shows the increase in CVD mortality rates in Spain since 2010 (figure 3).

Of all the various manifestations of CVD, Ischemic Heart disease (IHD), also known as coronary artery disease or coronary heart disease (CHD), is the most common across Europe (Timmis et al., 2020). The World Health Organisation states that 80% of premature heart disease death is preventable, mostly by controlling main risk factors such as smoking, unhealthy diet and physical inactivity (WHO, 2020a). The cause of IHD is blockages and restrictions, often resulting in a build-up of plaque, in the coronary arteries causing insufficient blood and oxygen levels (Wenger et al., 2010). A recent report by García-Ortiz et al. (2020) suggested the prevalence of CHD in asymptomatic individuals in Spain was 40%, which suggests that the population of Spain has a similarly severe public health issue with CHD as America (Sanchis-Gomar et al., 2016), although further investigation is required to substantiate these claims.

The presence of risk factors, even in younger individuals, increases the likeliness of developing CVD and potentially experiencing fatal or non-fatal CVD events (Rossello et al., 2019). Recent reports have indicated that the premature CVD mortality rates are increasing (Timmis et al., 2020), even in high-income countries such as Spain. Premature CVD mortality is used as a metric of identifying unfulfilled life expectancy, and usually indicates death occurring younger than 65 – 75 years.

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Figure 2: (A) Incidence of CVD, females, 1990-2015, European Society of Cardiology (ESC) member countries, (B) Incidence of CVD, males, 1990-2015, ESC member countries. High income countries were defined as countries with a gross income per capita ≥ US$12000, "middle income" countries represents a composite of upper- and lower-middle income ESC member countries Source: Timmis et al., European Society of Cardiology: Cardiovascular Disease Statistics 2017, *European Heart Journal*, 2018, 39, 7, 544.

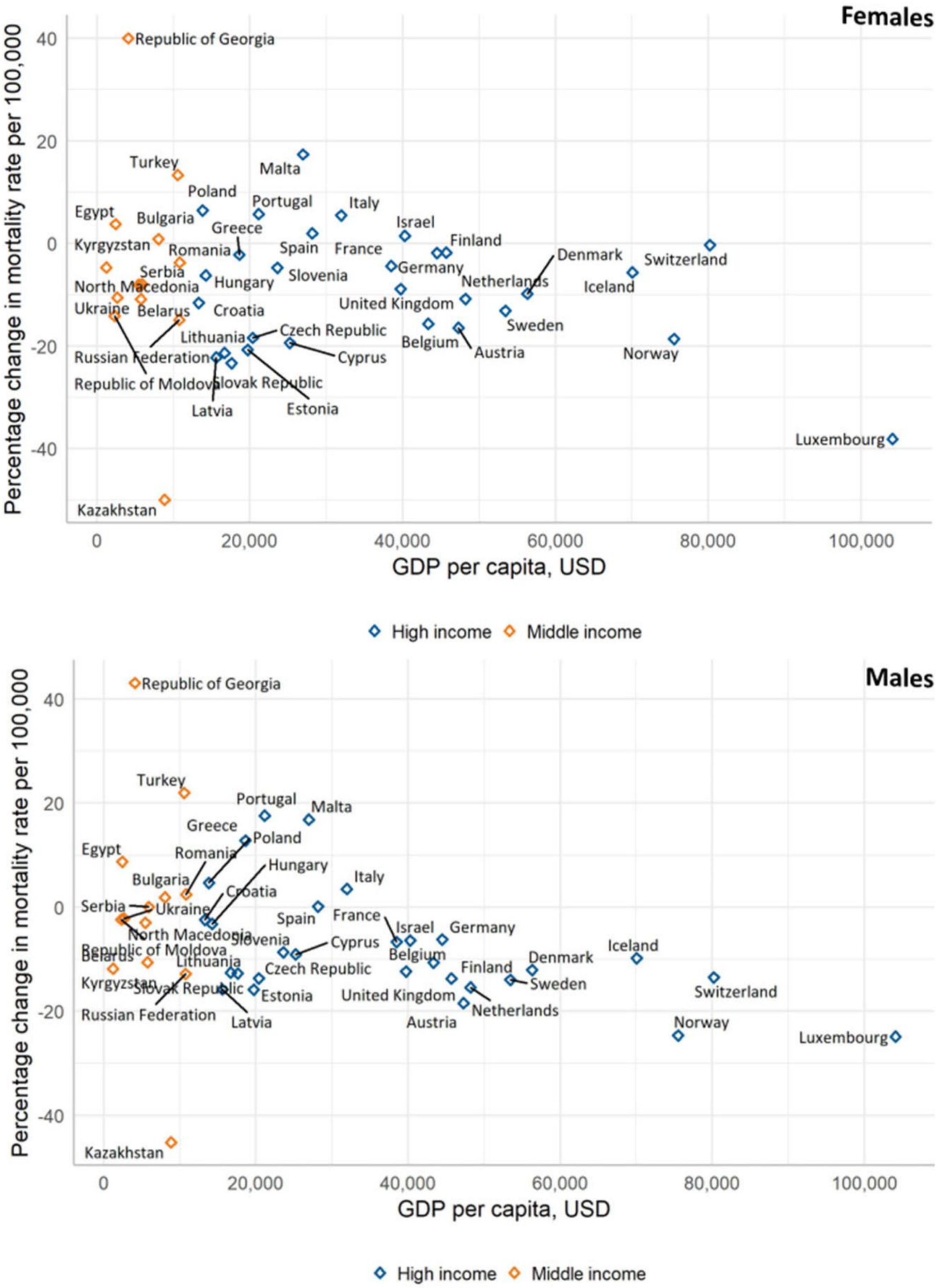

Figure 3: Change in CVD crude mortality rates between 2010 and latest year available among females and males aged <70 years in ESC member countries vs GDP per capita (US$, 2017).

2.2.3. Burden of CVD

Burden of CVD on the Economy

Cardiovascular disease alone brings an enormous burden to public health and government spending (Shaw et al., 2018). Globally, the treatment of CVD amounted to approximately $863bn in 2010 and the prediction from the Harvard School of Public Health, estimate that this will rise to over $1 trillion by 2030 (Bloom et al., 2012).

The British Heart Foundation reported that treating CVD now costs the British healthcare system £11bn per year and the total cost to the economy is £15bn, predicting that this will continue to rise. In comparison, Spain's economic cost of CVD is estimated to be almost €1.6 bn (Mayo et al., 2017), again predicting that this will continue to rise. A further way CVD burdens the economy is through absenteeism (Goettler et al., 2017). Absenteeism refers to the absence of an employee from their workplace and is calculated by the amount of work lost to unexpected illness or disease (Luedy et al., 2018). Obesity significantly increases the risk of absenteeism along with presenteeism, loss of productivity whilst at work due to illness, which has a significant financial impact on businesses and the overall economy (Luedy et al., 2018, Lehnert et al., 2013, Jans et al., 2007).

2.2.4. Burden to the Individual

Quality of Life and Mortality

For an individual, CVD has strong and well established associations with reduced quality of life and early mortality (Kaplan, 1988). Quality of life relates to one's ability to carry out daily tasks such as cleaning and gardening as well as to live without physical and emotional stress or without issues among personal relationships (Testa and Simonson, 1996). Furthermore, physical and mental health, self-esteem and daily lives are also impacted by CVD, contributing to decreased quality of life (De Menezes Caceres et al., 2018, Hutchinson et al., 2015).

Life Expectancy and Healthy Life Expectancy

Despite increasingly more deaths being attributed to CVD, it was reported that across a 35-year period (1980-2015), global life expectancy had increased from 61.7 years to 71.8 years. However, healthy life expectancy; defined as years without diseases such as CVD or disability, did not increase at the same rate. This caused a larger discrepancy between the two, meaning more years spent with ailments or disability. In Spain, this difference was 9.4 years for males and 11.2 years for females in 2010, which is less than a one-year increase in healthy life expectancy since 1990. Hence, this results in people living longer, but with an increased number of years spent with disability or illness (Lang et al., 2018). Spain shows one of the highest life expectancies in Europe, however healthy life expectancy data in these countries show the burden of disease later in life. Hence, the prevention of disease earlier in life, will likely provide improvements to healthy life expectancy.

The difference between life expectancy and healthy life expectancy is known as the average number of years lived in poor health. The proportion of life spent in poor health (%), helps our understanding of the implications poor health and associated diseases have, as a percentage of overall life expectancy. It is considered that those who sustain an active lifestyle will likely have a longer life expectancy, as well as reduced risk of chronic diseases, proposing less years spent in poor health (Ruiz et al., 2011). In a comparison with EU member states, the UK reported 6.9% for males and 7.4% for females at birth, of life spent in poor health, UK males showing higher rates than the EU average (6.5% males, 8.7% females). In Spain, males reported 5.3% of their life in poor health and females 8%, both below the EU average. These figures change significantly when considering the proportion of life spent in poor health beyond the age of 65. Spain report greater proportion for males at 16.5%, and females at 23.3%, compared with UK; males 13.8% and females 13.7%, respectively (Public Health England, 2018). These figures suggest that the burden of disease has a larger impact in the later years of life in Spanish citizens and is accompanied with a considerable decline in the amount of healthy years, as they approach older age.

Healthcare and financial burden

As healthcare became a political priority in the late 20th century, governments, particularly in the European Union, faced pressure to provide efficient and quality healthcare to meet the needs of its' patients (Mossialos and Le Grand, 2019). However, despite healthcare systems providing financial support to patients needing healthcare, high costs do still exist for various elements of healthcare such as prescriptions, and private treatment as to avoid long waiting lists in national healthcare settings. Healthcare costs therefore represents a financial burden to the individual. Unpaid work absence further contributes to this, requiring time off work due to absenteeism.

Hospitalisation

A report from Spain by Martínez and Del Llano Señarís (2019) provides important data from the health situation in its' communities. Hospitalisations can have a great burden to the individual in terms of costs and a reduced quality of life, and represent a good indication of the individual burden of CVD. Martínez and Del Llano Señarís (2019) identifies a large variation across many autonomies in Spain. In some regions, the number of hospitalisations for diabetes decreased slightly between 2012 and 2015, from 4.37 per 10,000 to 4.29 per 10,000; this improvement was evident in Madrid amongst other regions. Hospitalisations for hypertensive disease showed a very small decrease between 2014 and 2015 but not to below the figures reported for 2012. In Madrid there has been an increase between 2012 and 2014, representative of the nationwide average.

Socioeconomic Factors

CVD can affect anyone from any age range, background or location, although low and middle-income countries contribute the most deaths to the global figures attributed to CVD. However, when compared with other causes, the proportion of deaths due to CVD is even greater in high-income countries (De Menezes Caceres et al., 2018, WHO, 2012). In Spain, the percent of deaths attributed to CVD is 28%, with an unequal distribution of CVD risk factors depending on income and education level, resulting in higher mortality rates within lower socioeconomic groups (Di Girolamo et al., 2020, Veronesi et al., 2017). Socioeconomic issues highlight the need for investigations with large populations from various backgrounds and demographics, to provide insights into PA behaviour of those most at risk to elevated CVD risk factors (Fussenich et al., 2016, WHO, 2016).

2.3. Modifiable CVD Risk Factors

Many of the risk factors for CVD are described as modifiable as they relate to lifestyle choices such as smoking, alcohol consumption and physical activity (Kromhout et al., 2002). These lifestyle choices can have significant effects on various risk factors including hypertension, dyslipidaemia, obesity and diabetes (Christensen et al., 2006, Franklin et al., 2020, Hajar, 2020, van Oort et al., 2021).

2.3.1. CVD Risk Assessment

Assessment of risk for CVD differs between studies. Most commonly used in research are assessments of blood pressure, blood cholesterol, blood glucose and other blood parameters such as insulin and HbA1c, and a value of cardiorespiratory fitness (most often this is predicted VO_2max). Alongside these variables, measurements of body composition are also common due to the association with obesity and CVD. Most commonly used are mass, body fat percentage, ratio of waist to hip circumference and BMI. Physical activity has a very close link to cardiovascular risk level and this is supported in the ACSM's update to exercise preparticipation health screening recommendations (Riebe et al., 2015).

The American College of Sports Medicine developed a questionnaire and stratification criteria for pre-exercise testing, assessing CVD risk (Appendix 9.6), (ACSM, 2013). The ACSM risk stratification questionnaire provides a list of risk factors and a scoring-based system. Cumulative scores classify risk at different stages; low risk is classified as having less than two risk factors and no signs or symptoms of CVD. Moderate risk is classified as two or more risk factors and no signs or symptoms, and high risk as individuals show signs or symptoms and have documented cardiovascular, pulmonary or metabolic diseases (Maiorana et al., 2018, ACSM, 2006). Although it is not widely used in research articles as part of an outcome measure, studies have proposed that professional judgement is advised alongside the questionnaire, to use as an outcome measure (Thompson et al., 2013, Green, 2010).

2.3.2. Elevated Blood Pressure

Elevated blood pressure, also known as hypertension, is one of the leading risk factors for CVD, contributing to approximately 54% of strokes (Wu et al., 2015). A report developed for the European Commission by Martínez and Del Llano Señarís (2019) showed that hospitalisations from hypertensive disease had increased over the previous few years. Hypertension is defined in the NICE (National Institute for Health and Care Excellence) guidelines as having a systolic blood pressure which consistently exceeds 140mmHg and diastolic blood pressure exceeding 90mmHg (Jones et al., 2020).

The American College of Cardiology (ACC) / American Heart Association (AHA) guidelines state treatment should occur when “elevated levels” are recorded (Table 1) (Whelton et al., 2018). A systolic blood pressure of >120mmHg is defined as prehypertension and has links with CVD (Chobanian, 2003, Priyadarshini et al., 2019). The classification from Europe differs slightly to that of America (Table 2) (Williams et al., 2018), the most notable difference between classifications, is the categorisation of stage/grade 1 hypertension; the ESC/ESH guidelines categorise this 10mmHg lower than the ACC/AHA guidelines.

Whelton et al. (2018) showed that differing increments of blood pressure values, coincide with an increase in hazard ratios for CHD and strokes. Hence, further investigation is necessary to understand the reduction of CVD risk and the relationship with blood pressure in other populations. There is a genetic element to predisposing people to hypertension, however, the majority of cases are a result of environmental and lifestyle factors such as physical inactivity, obesity and insufficient dietary nutrients and minerals (Whelton et al., 2018, Savica et al., 2010).

Table 1: American College of Cardiology/Amercian Heart Association Categorisation of blood pressure (Whelton et al., 2018)

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Table 2: ESC/ESH Blood pressure classification guidelines (Williams et al., 2018)

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2.3.3. Elevated blood lipids

The blood lipid profile can be categorised as low-density and high-density lipoproteins (LDL-C and HDL-C respectively) and triglycerides. Studies also report total cholesterol and non-HDL Cholesterol (non-HDL-C) (Kühnast et al., 2015). Guidelines on the classification of lipid levels differ between Europe and the U.S. (Table 3; (NHS, 2019, BHF, 2021, Mach et al., 2020, Grundy et al., 2019). Classification of lipid levels as 'desirable' or 'elevated' are considered alongside other impacting factors such as age, sex, and family history within the literature. Primary hypercholesterolemia refers to elevated levels of the lipid profile; total cholesterol >200mg/dL (5.2mmol/L), LDL-C levels >160mg/dL (4.1mmol/L) or non-HDL-C >190mg/dL (4.9mmol/L), (Grundy et al., 2019, Lloyd-Jones et al., 2019).

Table 3: "Desirable" levels of blood lipids for adults from guidelines in Europe and the U.S. Sources: (BHF, 2021, Grundy et al., 2019, Mach et al., 2020, NHS, 2019)

Hyperlipidaemia refers to the elevated levels of lipids in the blood, which have significant associations with CVD, increased risk of heart disease, stroke, peripheral vascular disease and atherosclerosis (Navar-Boggan et al., 2015, Nelson, 2013). In a survey of physicians by the Centers for Disease Control and Prevention, hyperlipidaemia ranked as the second most prevalent chronic condition behind hypertension (Centers for Disease Control and Prevention, 2010).

It has been reported that 12% of American adults aged >20 years have total cholesterol >240mg/dL (Aimo et al., 2019), and the prevalence of elevated cholesterol in Europe has been estimated at 54% (WHO, 2020b). From a study based in Spain, primary care physicians were used to recruit almost 18,000 patients aged 18-80 years, and reported hyperlipidaemia in 49% of males and 41% of females (Casanueva et al., 2010). In a report from the WHO, elevated cholesterol contributed to approximately 2.6 million deaths worldwide each year, though it is likely this number has since increased (WHO, 2020b).

2.3.4. Body Composition

Body composition is the collective values and measurement of muscle, fat, water and bone. These values include body fat, visceral fat, waist circumference, waist to hip ratio and muscle mass. The classification of body fat levels have been categorised by the American Council on Exercise and define “acceptable” body fat as 25-31% for women and 18-24% for men (Mondal and Mishra, 2017). These guidelines are without age parameters, though they are provided by a study from Gallagher et al. (2000); healthy body fat percentage for women, 21-32% (age 20-39 years), 23-33% (age 40-59 years) and 24-35% (age 60-79 years), and for men as, 8-19% (age 20-39 years), 11-21% (age 40-59 years) and 13-24% (age 60-79 years).

Body composition values have well-established associations with cardiovascular diseases (Grundy et al., 2004, Irving et al., 2008). Excess visceral abdominal fat is accompanied by elevated triglycerides, blood pressure and low-density lipoproteins, which are associated with an elevated risk of CVD (Després, 2007). Furthermore, significant associations between incident CVD events and waist-to-hip ratio and waist circumference have been reported. A 1cm increase in waist circumference is associated with a 2% increase in the relative risk of a CVD event (De Koning et al., 2007).

Obesity and overweight refer to the composition of body mass and excess body fat, and are associated with poor diet and lack of PA. These behaviours affect changes to body composition, producing excess adipose tissue and the development of atherosclerotic plaques, thus increasing the risk of CVD, CHD and heart failure (Carbone et al., 2019). Worldwide obesity levels have almost tripled since 1975 (WHO, 2020c). There has been a large problem in the UK and US for many years; the British Heart Foundation reported more than a third of adults are overweight and 27% are obese in 2016, with this rising to 36% overweight and 28% obese in 2019 (British Heart Foundation, 2021). Spain has also observed an increase in the prevalence of obesity (+3% to 17.43%) and overweight, (+3.72% to 37%) between 2014 and 2017 (Martínez and Del Llano Señarís, 2019). Despite having lower levels of national obesity and overweight than the UK, Spain's figures represent a steeper increase in prevalence, which raises concerns for the future trajectory of the country's health (NHS, 2016, NHS, 2020).

The most frequently used diagnostic tool to classify body composition is body mass index (BMI), which is inexpensive and easy to test large populations (Gómez-Ambrosi et al., 2012, Frankenfield et al., 2001). Body mass index uses the simple formula of dividing body mass (KG) by the square of the persons' height (M^2). Despite the widespread use of BMI, this measurement does not provide an accurate representation of overall body composition, and in particular does not indicate excess body fat, its' distribution, nor distinguish between fat and lean tissue, which is the main factor in most obesity-related health risks (Poirier et al., 2006, Okorodudu et al., 2010). However, previous research has shown that BMI is still as good as or perhaps a better predictor of overall CVD risk (Ortega et al., 2016).

2.3.5. Elevated Blood Glucose

High blood glucose refers to an amount of sugar in the blood which equals or exceeds a fasting plasma glucose of 100mg/dL or 5.5mmol/L. An impaired fasting glucose diagnosis occurs between 6.1 and 6.9mmol/L fasting plasma glucose, referred to as hyperglycemia. The American Diabetes Association suggest a blood glucose level of 5.5mmol/L may be classified as prediabetes, with values just above the diagnostic cut-off, which would classify one as "at-risk" (Punthakee et al., 2018). Levels of HbA1c (glycated haemoglobin) have been shown to be linked directly with the incidence of microvascular and myocardial complications, and strong associations have been reported with elevated HbA1c and increase risk of CVD (Vinetti et al., 2015, Zhang et al., 2012). Complications from diabetes can include sight impairment and even amputation of the lower limbs, indicating a significant burden to individuals.

By the early 21st century, elevated blood glucose became one of the leading global risks for mortality across the world, responsible for approximately 6% of deaths globally (Mathers et al., 2009). In 2015 the prevalence of diabetes reached 8.8% of adults, and it is predicted that by 2040 this figure will reach 10.4% (Ogurtsova et al., 2017). Type 2 diabetes is a preventable disease, caused by lifestyle factors such as, poor diet, lack of exercise and prolonged sedentary time. Hence, clinical targets have shifted from treating and controlling the disease to preventing it (Bansal, 2015, Diab et al., 2019, Dyson et al., 2018). Type 2 diabetes accounts for almost 90% of all diabetes cases and is a major cause of morbidity and mortality across the world (Valentine et al., 2017). In Europe, it has been observed that approximately 39.3% of the adult population live with diabetes that is undiagnosed (Ogurtsova et al., 2017). A report from Spain showed that the incidence of diabetes is on the rise, observing a 14.37% increase in prevalence between 2014 and 2017 (Martínez and Del Llano Señarís, 2019). These figures show that diabetes continues to be a prevalent disease and a growing concern for public health in Spain and throughout the world.

Therefore, successful long-term management of type 2 diabetes also requires the additional consideration of weight management interventions such as increasing PA levels (Astrup and Finer, 2000). Increasing PA to improve weight management is one of many intertwined relationships between CVD risk factors which are linked with lifestyle changes as potential treatment options.

2.3.6. Cardiorespiratory Fitness

Cardiorespiratory fitness is frequently used as an evaluation and indication of physiological fitness and overall health status (Myers et al., 2015). Cardiorespiratory fitness reflects the ability and capacity of numerous bodily organs such as the heart, lungs and muscles, in supporting the energy requirements of PA (Ross et al., 2016). There is a consensus in the literature that has observed an association between low cardiorespiratory fitness and a clustering of other CVD risk factors, particularly in adolescents, which would also predict various health conditions such as hypertension and hyperlipidemia (Anderssen et al., 2007, Castillo-Garzón et al., 2007).

Maximal oxygen uptake (VO_2max), refers to the maximum amount of oxygen the body is able to transport and utilise during intense exercise and is considered to be the gold standard of cardiorespiratory fitness and aerobic endurance in large heterogeneous populations (Fitchett, 1985). Measuring VO_2max can be challenging due to the high-intensity and maximal effort required in absolute tests, as well as being expensive and time consuming (Grant et al., 1995, Ruiz et al., 2009). Nevertheless, sub-maximal tests can predict VO_2max with some accuracy (Fitchett, 1985). These consist of cycling, walking or running with increasing effort like the modified Balke protocol, and using an equation to predict VO_2max is reported. The sub-maximal method has shown a moderate to strong correlation strength with directly measured VO_2max values form maximal testing protocols (Smith et al., 2016).

2.3.7. Physical Activity

CVD risk can be improved with regular PA (Warburton et al., 2006). Improved physical activity behaviour can provide beneficial outcomes to fitness and hence improve CVD risk (Morrow and Freedson, 1994). A relative risk reduction of death of up to 35% can be achieved as a result of increased PA and fitness (Macera and Powell, 2001). Other reports have suggested a 50% reduction in the risk of mortality in men by being fit or active, and a 20% benefit by increasing activity levels by 1000 kcal/week (Hu et al., 2004, Myers et al., 2004). Compared with weight loss, sustained PA was associated with a substantial risk reduction in mortality in patients with coronary heart disease (Moholdt et al., 2018). Cardiac rehabilitation which includes physical activity has shown a 26% reduction in mortality in patients following myocardial infarction (Lawler et al., 2011, Varghese et al., 2016).

Many CVD risk factors can be positively affected by increased PA behaviour, such as; systolic and diastolic blood pressure, potentially through decreases in arterial stiffness, vascular resistance and reduced sympathetic activity (Diaz and Shimbo, 2013, Moraes-Silva et al., 2013). Physical Activity can also decrease the risk of hyperlipidemia by reducing total cholesterol, LDL-C and non LDL-C through stimulating enzymes which aid the removal of cholesterol from the blood to the liver for excretion (Lewis and Rader, 2005, Ohashi et al., 2005, Patnode et al., 2017).

Physical activity can also reduce the risk of diabetes, improve cardiorespiratory fitness and decrease the risk of abdominal obesity (Myers et al., 2015, Varghese et al., 2016).

2.4. Treatment for CVD Risk Factors

Many CVD risk factors can be treated with medication as a primary approach (Cook et al., 2019). Statins are used as a treatment for high cholesterol which is also known as HMG CoA reductase inhibitors, which prevent the formation of cholesterol in the liver. Further, Ezetimibe (branded as Ezetrol), has been shown to be an effective way of managing the lipid profile with other beneficial effects (Doherty, 2014, Knopp et al., 2003). However, the sustained use of statins may not be an effective long-term treatment, as research has shown an incident increase in blood glucose and possibly contributing to the development of type 2 diabetes (Sattar et al., 2010, Rajpathak et al., 2009). Similarly, usual treatment for diabetes consists of medication and insulin treatment if necessary.

However, due to some of the limitations with medication for reducing CVD risk as well as a rise in the prevalence of CVD, a focus has also been placed on lifestyle changes to improve multiple risk factors, such as maintaining a healthy diet and weight, exercising regularly, lowering alcohol consumption and not smoking (Larsson et al., 2016, Marques-Vidal, 2020, Masana et al., 2017). Lifestyle changes can be inexpensive and do not require doctor visits or hospital admissions like medication programmes often do. Exercise interventions have reported positive alterations to hypertension status, the lipid profile, body composition and other CVD risk factors, with a network meta-analysis suggesting similar efficacy compared to medication for some risk factors (Whelton et al., 2002).

2.5. Physical Activity and Exercise

A frequently recommended non-pharmacological option is increasing physical activity behaviour, decreasing the prevalence of physical inactivity and reducing sedentary behaviour (Buttar et al., 2005). Global recommendations such as those from the ACSM, include a combination of aerobic exercise, resistance training and flexibility training as an effective method of reducing multiple CVD risk factors (Pescatello et al., 2015, Schroeder et al., 2019). Modifying CVD risk factors through increasing PA is an affordable and effective way to reduce CVD and the burden to economies and the individual (Wei et al., 2015). The following sections define PA, exercise and sedentary behaviour, and outline the prevalence of these throughout Europe and Spain. The latter sections discuss the individual and economic burden associated with physical inactivity and CVD.

2.5.1. Definition of Physical Activity (PA) and Exercise

The use of the terms "PA" and "exercise" and what each consists of can be unclear from the literature. Therefore it is important to distinguish between the nomenclature when interpreting results, as terms are used interchangeably. By definition, PA refers to; "any bodily-movement produced by skeletal muscles which result in energy expenditure" (Caspersen et al., 1985). Daily tasks both household and occupation-related are included in this definition. Alternatively, 'exercise' is defined as a structured and planned set of PA which serves a purpose or objective, usually to improve or maintain physical fitness (Caspersen et al., 1985, Mann et al., 2014).

Definition of Sedentary

Whilst the terms sedentary and physical inactivity have been used interchangeably in the literature as synonyms, they are different. Sedentary behaviour refers to an absence of ambulatory movement or more specifically, physiological expenditure of <1.5 metabolic equivalents (METs), in a seated or reclined position, whilst in wakefulness (Sánchez-Oliver et al., 2018). Physical inactivity refers to being insufficiently active to meet the recommended physical activity guidelines. It is also worth noting that individuals can be physically active by meeting guidelines as well as devote a significant part of their time to sedentary behaviours, by definition.

2.5.2. Measuring PA

Obtaining a reliable and accurate value for an individuals' overall PA can be challenging. Most common methods consist of either objective measures or self-report questionnaires. A study from Hagströmer et al. (2006) reported acceptable validity of the IPAQ in adults following comparison with data from activity monitors and PA log books. Convergent validity of each category of PA in the IPAQ was also confirmed by a meta-analysis of 21 studies by Kim et al. (2013) which used other instruments (accelerometers, pedometers etc.) as moderator variables for the corrected mean effect size. Objective methods of measuring PA include accelerometry and pedometer devices as well as calorimetry. Accelerometers measure the amplitude and frequency of acceleration of the body in varying planes of motion (Chen and David R Bassett, 2005). They can be wrist-worn or waist-mounted, although there are often challenges with estimating certain types of activity using these methods such as upper body activity or cycling (Warren et al., 2010). Furthermore, some models also may not be waterproof and thus need to be removed prior to aquatic activity. A benefit of objective measures is that activity is captured in real-time and hence activity patterns can be obtained, rather than relying on an estimate of activity from a given week (Melanson Jr et al., 1996).

Questionnaires require an estimation of total time spent performing various intensities of activity; walking, moderate or vigorous. For an overall PA estimation of the week, the International Physical Activity Questionnaire (IPAQ) uses a formula which assigns a metabolic equivalent (MET) value to each intensity of activity. One MET is defined as the basal rate of oxygen consumption and associated calorie cost or the amount of energy required when sitting quietly (Warren et al., 2010, Tompuri, 2015). There are some limitations to this method, as it groups activities of varying intensities within either moderate or vigorous and so could under- or overestimate PA levels. For example the compendium by Ainsworth et al. (2011) provides a more comprehensive database of MET levels for activities whereas the IPAQ simply allows for the selection of activity performed at either 4 or 8 METs. Furthermore, some versions of the IPAQ will ask for PA levels over the course of the previous week or to reflect a “typical” week, which again may cause inconsistencies within responses and cause overestimations of PA. However, the IPAQ is widely used within the literature for predicting PA levels, and can be used as self-report or as an interview-based measure for PA surveillance (Bauman et al., 2009). It also requires minimum preparation and is both time and cost-effective to use in large populations. Previous studies recommend its use for large populations and alongside other methods of PA surveillance (Bauman et al., 2009, Boon et al., 2010).

The reliability of the IPAQ has been questioned in studies previously (Medina et al., 2013, Brown et al., 2004, Tomioka et al., 2011), though has been reported as ‘acceptable’ (Dinger et al., 2006), and is recommended for international prevalence studies (Craig et al., 2003).

2.5.3. PA Guidelines

There is a general consensus for the recommended amount of weekly PA. In the UK, the Chief Medical Officer's Physical Activity Guidelines recommends 150 minutes of moderate PA or 75 minutes of vigorous PA per week, or a combination of both, for adults and is consistent with recommendations from the World Health Organisation (Bull et al., 2020). Achieving the guidelines equates to performing >600 $MET.Mins.Wk^{-1}$, to be classed as physically active. For further context, moderate intensity PA (3-5.9 METs) has been defined as exerting more than minimal effort including light cycling and playing doubles tennis but does not include walking (Ainsworth et al., 2011). Vigorous intensity PA (>6 METs) (Ainsworth et al., 2011) has been defined as requiring hard physical effort such as heavy lifting, aerobics and fast cycling (Rebar et al., 2016). Spending prolonged time in a sedentary state has also been shown to be associated with negative health effects, but is a separate behaviour from PA (Biswas et al., 2015, Healy et al., 2011).

Following the guidelines from the WHO, individuals who are not achieving the PA levels to be classified as active, are reported as inactive. "Physically inactive" has been defined as not performing moderate to vigorous PA (3-5.9 METs is moderate, >6METs is vigorous), long enough to achieve the recommended amount of PA (van der Ploeg and Hillsdon, 2017). However, considering the guidelines from Sport England, there is another category; 30-149 minutes per week, which is not included in the WHO or the Chief Medical Officer's guidelines. This category allows for a "fairly active" classification, which bridges the PA gap and thus prevents people performing no PA and those performing 149 minutes per week of PA as the same activity level. It could be argued that this distinction is important as it is unlikely that individuals performing, for example 5 minutes per week of moderate PA and 149 minutes per week of moderate PA, achieve the same health benefits as a result.

2.5.4. Prevalence of PA, Exercise and Sport

Physical activity levels are a concerning area for public health all over the world, (Oja et al., 2010). Reports outlined 28.6% of the EU population do not meet the WHO's recommendations for PA (Gerovasili et al., 2015). Physical Activity factsheets outline the prevalence of sufficiently active adults from European countries; Spain 66% and England 67% (WHO, 2018a). Direct comparisons between countries from this report are challenging due to the differences regarding the data collection, differing definitions of “sufficiently active”, the age bracket used to define an adult, and the most up-to-date reports from different countries varying in publication date. The WHO’s Physical Activity report for Spain, indicates that around 66% of the adult population (18-64 years) achieve the recommended PA guidelines (WHO, 2018b). Spain reported the third least percentage of the population performing moderate PA on 4-7 days per week (17%), significantly lower than the average of EU15 at 25% (European Group, 2018). Throughout Europe, it has been reported that 40% of the European Union population exercise at least once a week (European Group, 2018). The Eurobarometer shows that almost half (46%) of Europeans reported they never exercise or play sport, an increase of 7% since 2009, though these individuals may still be able to achieve the PA guidelines via moderate PA. There are approximately 20 million adults in the UK whom are not physically active and PA levels have remained low over the past few years (British Heart Foundation, 2019, Sport England, 2019).

The Spanish National Health Survey, administered by the National Institute for Statistics (INE) in collaboration with the Ministry of Health, Social Services and Equality, alternate with the European Health Survey for Spain in reporting PA levels of the population. The most recent publication reflects the 2020 year and was published April 2021. These two surveys share conformity to allow for one series of reporting between them. Regular and consistent national health surveys like these are important in developing health policy through reporting the progress of current health policies and initiatives.

The report on PA and sedentary behaviour by Mayo et al. (2017) suggests that the larger and well-developed EU member states who joined before 2004 (EU15) are the countries showing the highest levels of PA. However, Spain’s PA levels are much lower than the average of these countries with only 29% reporting exercising “with some regularity” (1-4 times per week) compared with 34% in the UK. Furthermore, a larger proportion of the population of Spain reported not practicing any moderate PA (57%, Figure 4) which is considerably greater than the average for the EU (EU28; 44%) (Figure 4, 5).

Global studies have outlined a very high prevalence of sedentary behaviour, and particularly in the US (Ozemek et al., 2019). In Spain the IBERICAN observational study reported sedentary behaviour in 28.2% of the population (Cinza et al., 2017). There has been an increase in the sedentariness of the global population over the last few years, which may be due to the introduction of technology in many aspects of life, as well as new approaches to socializing, working and commuting (De Craemer et al., 2018).

The Special Eurobarometer 472 “Sport and Physical Activity” contained 1,024 respondents constituting the Spain data. Their reporting uses a basic, multi-stage, random (probability) sampling method whereby countries are drawn sampling points based on population size and density. As a result of the global pandemic caused by SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), recent studies have reported less active Spanish citizens becoming more active during ‘lockdown’ yet highly-active individuals reported being less active, and other studies have suggested an overall negative impact on PA levels in Spain (Martínez-de-Quel et al., 2021, Pérez-Rodrigo et al., 2021). The implications of COVID-19 should be considered when discussing the targets aligned with the Global Action Plan for PA.

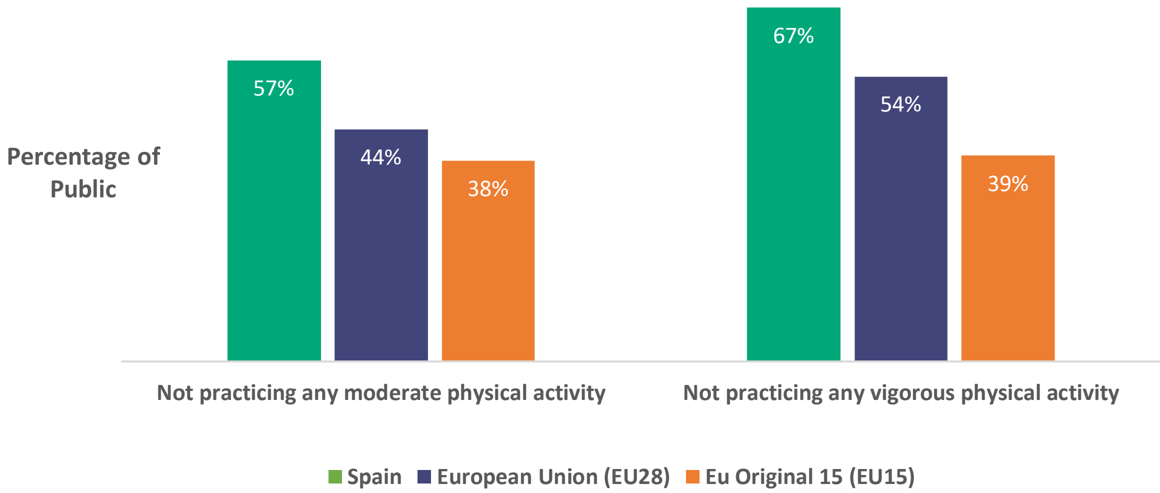

Figure 4: Percentage of the population not performing moderate PA and vigorous PA in the last seven days, in Spain, European Union and the Original 15 European Union Countries

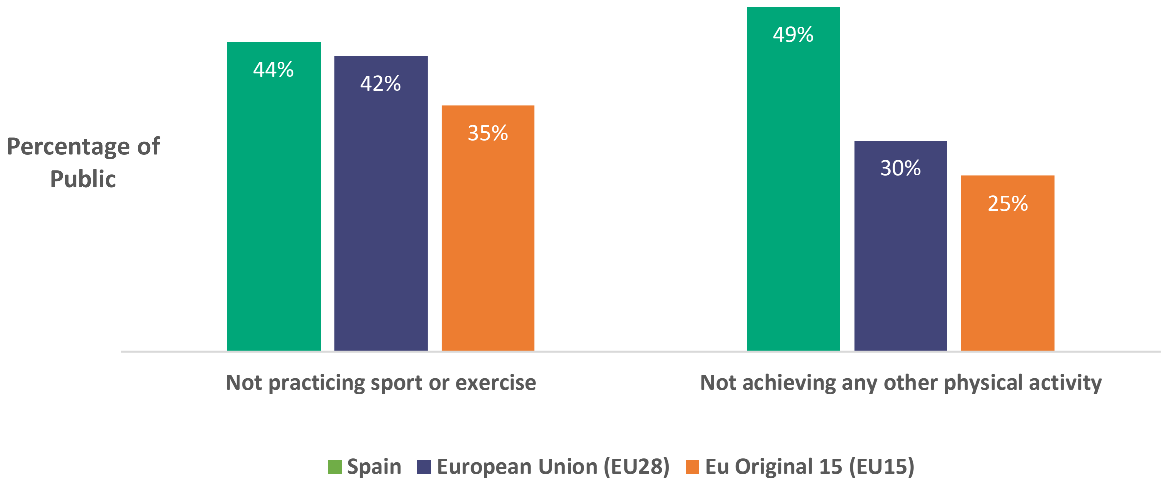

Figure 5: Percentage of population not engaging in exercise or sport in the last seven days, and not achieving any other PA in Spain, European Union and the Original 15 European Union Countries

2.5.5. Physical Inactivity and Burden to Economy and Individual

Physical inactivity exerts a large burden on the economy, with the global healthcare costs reaching approximately INT$53.8bn (Ding et al., 2016). The World Economic Forum cited in Bloom et al. (2012) also predicted that the economic production loss and cost of healthcare between 2011 and 2030 will accumulate to $47 trillion, worldwide, a significant burden on the economy over the next decade. Insufficient physical inactivity has been shown to negatively impact quality of life with links to increased stress, decreased social well-being and reduced physical health and balance (Rejeski and Mihalko, 2001). Further, in Spain 13.4% of deaths attributed to CVD are linked to physical inactivity (Fussenich et al., 2016, WHO, 2016).

2.5.6. Barriers and Facilitators of the prevalence of PA

Many factors can contribute to the PA behaviours of a country and region. Barriers to PA refer to obstacles which may prevent them from meeting PA recommendations. For example, weather as well as education level, occupation and income, facilities, demographic, biological, cognitive, emotional, sociocultural and environmental factors (Bauman et al., 2002). Motivation has also been referred to as a frequently reported barrier to exercise, and is explained in more detail, with reference to the theoretical models in later sections of this chapter. Women may experience different barriers to men and lower socioeconomic status individuals may experience different barriers than those of higher socioeconomic status. Health-related barriers to PA are frequently studied in the literature and are a clear barrier to achieving PA recommendations, particularly those with chronic conditions such as cancers and CVD (Bullard et al., 2019). Facilitators of PA are factors which positively influence the PA levels of individuals, an example of this could be social support from peers or easy access to nearby facilities (Alvarado et al., 2015).

A review and meta-analysis by Van Cauwenberg et al. (2018) outlines the environmental barriers associated with achieving leisure time PA in older adults. Significant relationships between the design of neighbourhoods, access to public transit and open space and parks were observed, thought other environmental attributes were insufficiently studied in the literature to draw conclusions. A review of 19 reviews by O'Donoghue et al. (2018) reported convincing evidence for a relationship between socioeconomic status and PA supported by >75% of the available original studies, especially with regards to leisure time. Further, Hobbs et al. (2018), investigated PA environments (locations where PA can be performed such as leisure facilities, parks and recreational areas) and the associations with obesity and individual-level socioeconomic status in the UK. Individuals were less likely to be obese if situated in favourable PA environments (in close proximity to PA environments), and stratified for education level, this association was only present in those with higher education level. Reports from the U.S and Europe also show favourable associations between PA levels and proximity to parks and recreational environments (Kaczynski and Henderson, 2007, Cohen et al., 2007, Schipperijn et al., 2017). Likewise in Spain, living in rural environments increased the risk of insufficient PA, potentially due to a lack of access to public fitness centres, as did a lower education level (Serrano-Sanchez et al., 2012). However, studies like these have limitations such as, people with higher socioeconomic status are more likely to reside in neighbourhoods closer to favourable PA settings, as well as have good access to public transport routes. The barriers or facilitators for PA need further investigation in various locations and populations (Boone-Heinonen et al., 2011).

2.6. The Effectiveness of Exercise Interventions on CVD Risk Factors

Investigations in controlled settings such as human exercise laboratories, have provided resounding evidence that exercise interventions have beneficial effects on CVD risk factors. These studies are useful in understanding the cause-effect of interventions within specific populations (Cornelissen et al., 2011, Cornelissen and Smart, 2013, Kelley et al., 2006, Schwingshackl et al., 2013, Whelton et al., 2002). Studies report strong efficacy of exercise interventions, although to determine the effectiveness, these interventions require scaling-up in settings where the findings would have greater ecological validity, and better represent a usual exercising environment (Spieth et al., 2016).

Ecological validity has often referred to the generalisability of behaviour observed in laboratory settings to natural behaviour in the real world (Schmuckler, 2001). There is some ambiguity surrounding the definition in the case of exercise studies, mostly due to a lack of verified criteria, particularly for exercise experiments being replicated in the real world. It is considered that ecological validity refers to elements and conditions that relate to the exercising environment such as setting (laboratories, gymnasiums, parks), supervision (if the exercise is supervised by a researcher/fitness instructor or unsupervised) and whether the facilities and equipment, and access to these are the same. Better ecological validity in this area of literature would mean the conditions under which the experiment was conducted, reflect the typical conditions expected in the naturalistic exercising environment. This is very important when considering the outcomes of experimental studies, and whether they will be achieved once scaled-up to the general population. For example, if the conditions in the experiment include a 1-to-1 supervisor, no other people in the exercise environment and the same access to facilities and equipment used in the study.

2.6.1. Types of Exercise

Aerobic exercise was the most frequently used exercise intervention and was considered the most effective at providing health benefits and reducing CVD risk (Blumenthal et al., 1989, Heran et al., 2011, Pinckard et al., 2019). Research focused on varying the volume and intensity of aerobic exercise to investigate the most effective intervention at improving health outcomes (Dubbert et al., 1987, Brownell et al., 1982, Blair et al., 1984). Training types have since been combined to incorporate aerobic exercise with weight or resistance training and flexibility and balance exercises (Perez-Terzic, 2012).

Aerobic Exercise

The American College of Sports Medicine (ACSM) define aerobic exercise as, "any activity that uses large muscle groups and can be maintained for prolonged periods of time", the main examples being; cycling, long-distance running and swimming. Hence, the muscle groups activated by these exercises rely on aerobic metabolism to produce energy in the form of adenosine triphosphate (ATP), by utilising the oxygen supplied by the cardiorespiratory system.

Meta-analyses of aerobic exercise studies such as those from Lin et al. (2015) and Kelley et al. (2006) have reported successful improvements in CVD risk factors and reductions to overall CVD mortality (Smith 2006, Dumortier *et al.* 2003, Johnson *et al.* 2007, Ho *et al.* 2012). The effectiveness has been shown to be dependent on the volume of exercise with consideration of intensity, frequency and duration of the intervention. An exercise intensity of between 60-85% maximum heart rate (HR), and an intervention frequency of at least twice a week was suggested in a review by Chudyk and Petrella (2011). They found that aerobic exercise programmes were associated with a decreased risk of microvascular complications compared with resistance training programmes, in patients with type 2 diabetes. The reduced risk was due to a reduction in HBA1c, a blood sugar indicator, which subsequently decreased the risk of myocardial infarction rate, thus showing aerobic exercise to be beneficial in numerous populations for CVD risk reduction.

Many studies have investigated manipulating exercise intensity to achieve the greatest effectiveness at improving CVD risk factors. The term 'intensity' most often refers to the amount of energy that is expended during activity, and is described usually as a percentage of maximal capacity, such as VO_2 max. It is sometimes expressed as the perceived amount of effort required to expend such activity, like the rate of perceived exertion (RPE). Alternatively, metabolic equivalents (METs) are used to define the intensity of activities and place a value on energy expenditure (Borg, 1998, Morgan, 1994, Norton et al., 2010). Gaesser and Rich (1984) showed that aerobic exercise training at an intensity of 45% VO_2max is sufficient to produce beneficial outcomes to aerobic capacity, reducing the risk of CVD by providing cardio-protective benefits (Swain and Franklin, 2006, Britton et al., 2008). It is suggested that these benefits are further enhanced with a greater intensity of aerobic exercise.

High-intensity exercise training is regarded as more time-efficient and can potentially illicit greater benefits to health outcomes than low-intensity aerobic exercise (El-Sayed, 1996, Rognmo et al., 2004, Schwingshackl et al., 2013, Shiraev and Barclay, 2012, van Santen et al., 2002). A review by Lavie et al. (2015) suggested that high-intensity aerobic exercise (85-90% VO_2 peak), was more effective than continuous low-moderate intensity training (Støylen et al., 2012). Aerobic exercise programmes of high intensity may rely on supervision to achieve sufficient adherence, as well as possibly requiring at least average health or fitness status at baseline, to achieve significant positive results (Fennell et al., 2016).

Aerobic exercise programmes have been shown to improve body weight (–1kg vs –0.2kg), CRF (change in time spent performing CRF test, aerobic training = +72 secs vs resistance training = +12 secs and achieve greater fat mass reductions than resistance training (–0.9kg vs –0.3kg) (Schroeder et al., 2019, Schwingshackl et al., 2013). Aerobic exercise provokes these changes to the body due to an increased metabolic demand, including adaptations to the cardiovascular system. There are numerous mechanisms which mediate the benefits of aerobic exercise such as angiogenesis (growth of capillaries) and vasodilation of the arteries which improve the delivery of oxygen to cells and hence improve the efficiency of the cardiovascular system (Kissane and Egginton, 2019, Pinckard et al., 2019). Investigating the effectiveness of these exercise programmes in real-world settings, scaled up and implemented as public interventions which have greater ecological validity is required.

Resistance Training

Resistance training refers to a periodic exercise using external weight to provide progressive overload to skeletal muscles, resulting in hypertrophy (Phillips and Winett, 2010). Cross-sectional studies reported an inverse relationship between muscular strength and all-cause mortality and the prevalence of metabolic syndrome (Jurca et al., 2005). Resistance training is endorsed by the ACSM and American Heart Association (AHA), for inclusion as part of an exercise programme aimed at the prevention of CVD and health promotion (Pescatello et al., 2015). However, it has been suggested that resistance training should complement an aerobic exercise programme, rather than be a substitute for it, when prescribing exercise for CVD risk reduction (Meka et al., 2008). Resistance training programmes have beneficial effects on hypertension (SBP = –3.2mmHg, DBP = –3.5mmHg) (Braith and Stewart, 2006). Many studies compared the effects of aerobic exercise interventions against resistance training, often finding that the different interventions improved separate health outcomes. For example, resistance training is more likely to improve muscle mass which has been shown to protect against hypertension (Butcher et al., 2018), whereas aerobic exercise is more suitable at improving CRF, reducing body weight and fat mass (Gupta et al., 2011, Schroeder et al., 2019).

Combined Exercise

In the literature, most often “combined exercise” refers to an exercise programme consisting of aerobic exercise and resistance training together. Literature reviews such as those by Gaede and Pedersen (2004), Chudyk and Petrella (2011), and Snowling and Hopkins (2006) reviewed exercise interventions and suggest that combined exercise methods produce beneficial outcomes to multiple CVD risk factors; including risk factors improved by aerobic and resistance training independently, such as CRF and blood pressure (Marzolini et al., 2012, Saeidifard et al., 2019). However, further high-quality evidence of combined interventions is still required to support wide spread adoption of these programmes, and to understand the clinical significance of combined exercise programmes. Many studies included in these reviews are based on specific populations, mostly those with elevated risk profiles at baseline. Hence further study of healthy populations is necessary. These reviews also do not consider the impact of the exercising environment or supervision of the included studies which can influence the effectiveness of the programmes, as their findings may not be replicated well in other exercising environments. Further, some studies include a dietary intervention which could affect the changes in some CVD risk factors such as blood glucose levels, rather than exercise without dietary intervention.

2.6.2. Location of PA and Exercise

Exercise and PA can take place in various locations, although for the purpose of investigations these are most often situated in exercise laboratories and controlled environments. For the implementation of PA and exercise programmes which are successful at improving CVD risk factors, laboratory-based interventions must be scaled up and performed in public environments. These better replicate exercising environments for the public such as fitness centres. Fitness centres have become more accessible to the public in recent years as they become more prevalent and with more affordable options (Herman et al., 2019, García Fernández et al., 2016).

PA and Exercise in Public Fitness Centres

Public fitness centres have been called upon to be the “hub” for PA promotion by the European Health and Fitness Association (EHFA, 2011). Fitness centres offer the potential to increase PA levels at scale, creating “active societies”, with an ideal environment and exercise options for the public to engage in PA to achieve the Global Action Plan (WHO, 2019). The accessibility of fitness centres has improved throughout the last decade as more cheaper options become available through the investments of local authorities in growing low-cost fitness facilities (García-Fernández et al., 2018). Public fitness centres represent a best-buy option for public health improvement as they consist of facilities and equipment enabling greater PA behaviour, support from staff to engage in activities and have a wide range of exercise options available. Centres are now becoming more frequently opened in areas which are further away from city centres and in low-income areas. From a research perspective, fitness centres contain large populations, and a diverse demographic, which exercise in a natural environment, that can be studied for the improvement of health and PA surveillance.

It has been reported that approximately 50% of fitness centre members renew their membership after one year, with reported reasons consisting of lack of time and loss of motivation. Yi et al. (2021) describes how membership retention as is reliant on frequent and continuous visits to the centre, with intrinsic and extrinsic motivations playing a key role in continuing exercise activities (Fraser et al., 2019). Studies based in community settings are often criticised for their low retention levels however, these numbers may be similar to the usual retention numbers in fitness centre membership

(MacIntosh and Law, 2015, Sperandei et al., 2019). For example, Gondim et al. (2015) started with a population of over 600 participants and retained 143 participants, who completed the exercise programme in accordance with the criteria. Similarly, a community-based exercise programme witnessed a retention of 32 participants from 65 at baseline (Webb et al., 2016). Another limitation with the literature in this area is that many do not report adherence, retention or give a completion criteria from baseline to participants who are included in final analysis. Lack of information causes issues with understanding the effectiveness of an intervention regarding engagement and the potential for long-term sustained, regular PA and adopting a more active lifestyle.

Whilst previous research has outlined the potential of public fitness centres in improving PA behaviour, it remains that initiatives should aim to engage populations that currently do not utilise these services. For example, previous indications are that general practitioners could be more informed and better equipped to provide PA advice to their patients, including the available locations and facilities which are available. In general, patients have shown that they are willing to take the advice of doctors even in cases where this overrules the patients' preferred treatment options (Van Swol and Sniezek, 2005, Fotaki et al., 2005, Mendel et al., 2005). Further, individuals are more likely to adhere to physical exercise when it has been prescribed by a healthcare professional (Collado-Mateo et al., 2021). Social schemes may also help engage non-members in using fitness centres, such as social media campaign as well as word of mouth and referrals from current members, like incentivising members to bring a friend. It has been shown that social media campaigns for sharing health knowledge and promotion of healthy behaviours are likely to be shared if the source is credible (Jin et al., 2021). Previous social media campaigns such as, "#JoinTheMovement" and "This Girl Can" were successful at improving intent to exercise in females, although did not significantly improve exercise behaviour (Mulgrew et al., 2018). Further, public fitness centres have the capacity to reach priority groups and those in need of behaviour intervention in many novel ways, such as undertaking virtual exercise classes to members remotely and changing the exercise environment bringing equipment to outdoor spaces and away from gym floors which may be an intimidating place for novice exercisers. Further, using general practitioners to engage in conversations with their patients, and using social media will also aid investigations aimed at discovering the reasons why these groups do not engage with public fitness centres. Additionally, public fitness centres themselves should adopt a questionnaire for members who drop-out or have very low-attendance, to better understand their needs, or to ask why their friends or family members may not be engaging in PA.

2.6.3. Adherence and Retention to Exercise programmes

Adherence refers to the participants' acts in accordance with the demands of the programme. However, for some studies adherence can be defined as the completion of the programme (retained by the end of the intervention), attendance of sessions, exercise duration, or exercise intensity (Hawley-Hague et al., 2016). Therefore, the specific definition proposed by each study should be understood when interpreting and analysing adherence results. Retention refers to the continued adherence for a prolonged period of time. Retention can be sustaining the exercise programme beyond testing intervals or beyond the cessation of the study. Retention could relate to the renewal of fitness centre membership beyond the inaugural year. Adherence and retention to exercise programmes can be affected by many factors, both individual such as motivation, and environmental such as access to facilities. Public fitness centres present an environment that will potentially improve adherence and retention for long-term sustained exercise. Typically, a fitness centre environment provides opportunity for peer-support, motivational support in the forms of environmental cues and support from trainers and others in the centre and open-access to a range of facilities.

Sperandei et al. (2019) reported that drop-out from health interventions is health-related or due to a lack of motivation. Retaining a larger proportion of the original sample is important as this provides evidence that the intervention was engaging, suggesting it would be an effective public health intervention. One factor that has been shown to improve adherence and retention is supervision. A study by Vinetti et al. (2015) reported no drop-outs after completion of a 12-month, structured exercise programme. An updated review of public based interventions will perhaps show the impact that supervision has on the effectiveness of exercise interventions compared with unsupervised, on CVD risk factors as well as adherence and retention to an exercise intervention.

Lab-based and supervised interventions typically have very high-adherence, possibly due to the external motivation provided with a researcher or health care professional monitoring the programme, or other environmental factors. Studies based in laboratories and clinical settings do not accurately reflect exercising behaviour of the general population, which are placed in public settings, and usually unsupervised, which may negatively impact adherence and retention. Methodological factors are an obstacle in this area, limiting the true application of this research. Therefore, efforts should be made to design long-term interventions in fitness centres or community-based settings, without supervision. As the issues of CVD and physical inactivity are increasingly prevalent, a review of these interventions is appropriate to inform research, policy and stake-holders on what has been investigated, and which interventions are the most promising regarding retention, adherence and creating and sustaining a life-long approach to PA.

Motivation to Exercise

Motivation has been defined as, “the process that influences the initiation, direction, magnitude, perseverance, continuation and quality of goal-directed behaviour” (Maehr and Braskamp, 1986). Other reports describe the cognitive processes and self-regulation which affect motivation as the term has been regarded as vague (Roberts and Treasure, 2012). When considering the factors that contribute to the uptake, adherence and maintenance of PA and exercise, behavioural sciences which underpin the motivational aspect of these activities must be acknowledged and understood. Contributing elements such as; social, environmental, cultural and particularly psychological factors are malleable with effective intervention (Hagger and Chatzisarantis, 2008). Previous reports showing low national PA levels, have suggested that many individuals lack the motivation to engage in PA to achieve recommendations (Garber et al., 2011). Individuals prefer to have personal assistance when initiating or increasing exercise participation and that supervisors can provide motivational skills and accountability (Hunter, 2016, Nicolaï et al., 2009, Melton et al., 2010, Melton et al., 2011, Quinn, 2010). Interventions that consider the motivation of individuals, targeted around behaviour change to influence PA behaviour are not fully understood (Wallace et al., 2000).

Most behaviour change and motivation-based models have previously focused on social cognitive approaches which is the dominant model used in behaviour research. However, the humanistic approach extends beyond behaviour as a response to either reinforcement or punishment, and instead considers inherent human needs (Rhodes et al., 2019). Self-determination theory has particular relevance to PA and exercise and has investigated sustaining healthy behaviour and PA (Deci and Ryan, 1985, Silva et al., 2008). At the core of self-determination theory is the distinction between autonomous and controlling motivation; whether the motivation for behaviour is self-determined or a means to an external end. The theory contains three sub-theories which sit within the self-determination continuum (Figure 6) proposed by Ryan and Deci (2000). The first sub-theory is cognitive evaluation theory and outlines the “undermining effect” whereby behaviour performed as a result of external motivation will only persist when the reward is pervading, and desist when the reward is removed (Hamner and Foster, 1975). Organismic Integration theory has been used in research assessing the motivation of exercise engagement. The theory outlines a continuum of motivation rather than polar scale, and consists of autonomous forms of motivation which are intrinsic, to controlling forms known as external and introjected regulation (Ryan and Deci, 2000). This sub-theory includes “integrated regulation” (Figure 6) explaining how the person identifies with the behaviour they are engaging in, meaning this behaviour will continue, irrelevant of external rewards or pressures. For example, this may pertain to the disengagement of fitness centre membership once a target body weight has been achieved, and hence would affect long-term engagement (Wasserkampf and Kleinert, 2016, Ryan and Patrick, 2009). Finally, the Basic Needs theory explains the origin of self-determined motivation by performing behaviour to satisfy three basic psychological needs: autonomy, competence and relatedness. This theory derives the origins of self-determined motivational regulations, and the extent that the perceived locus of causality has been internalised and is supported by Charness and Gneezy (2009), who discuss the incentives to exercise.

Figure 6: The Self-Determination Continuum, (Ryan and Deci, 2000)

The Exercise Motivations Inventory (EMI) was proposed initially to identify the impact of exercise motives on the individual's propensity to participate in various physical activities (Deranek et al., 2020, Markland and Ingledew, 1997). Comprising of 12 scales including; stress management, weight management, recreation, social recognition, enjoyment, appearance, personal development, affiliation, ill-health avoidance, competition, fitness and health pressures. The EMI-2 was then developed and renamed some of the original items and added two further items to the fitness scale; strength and endurance, and nimbleness (Markland and Ingledew, 1997).

Previous research has focused on developing a construct to understand how to accurately design interventions aimed at behaviour change (Michie et al., 2011). Some research has focused on the stages of behaviour change in regards to PA, ranging from pre-contemplation to maintenance, whereby the exercise behaviour has been performed consistently for six months (Lowther et al., 2007). Coinciding with the stages of behaviour change are the 10 processes, including experiential and behavioural constructs (Marcus et al., 1992b). The Theoretical Domains Framework has been used to inform the analysis of behaviour change in PA (Alexander et al., 2014). Another model used is the COM-B model, standing for; capability, opportunity and motivation – behaviour. Furthermore, the "Behaviour Change Wheel" within this approach, is a framework building on the relationship between these factors and shows the non-linear interaction between policy categories, intervention functions and sources of behaviour (Figure 7). The COM-B model has been applied to a physical health promotion context and has been successful in influencing the design of interventions which have had success in decreasing sitting time and promoting PA (Munir et al., 2018, Howlett et al., 2019, Robinson et al., 2019, Nelligan et al., 2019).

Figure 7: The Behaviour Change Wheel (Michie et al., 2011).

2.7. Conclusion

This chapter has defined the key terms in this area, explored global and national public health circumstances and discussed the impact of physical activity and CVD. A growing concern across Europe was found, with Spain reporting rising CVD cases and prevalence of physical inactivity similar to the UK. Effective strategy and public health interventions are required in Spain so that health targets can be met.

Chapter 3.

The Effectiveness of Community-based Exercise Interventions on CVD Risk Factors in Apparently Healthy Adults, A Systematic Review

3.1. Introduction

The previous chapter provided an insight into the current situation regarding PA levels and the impact CVD has as a global health issue. Whilst randomised controlled trials and investigations set in laboratories are important in terms of understanding the specific impact of PA and exercise on CVD risk factors, they may not be representative of public health initiatives when provided in community-based settings. Hence, this chapter will systematically review the current evidence of PA and exercise programmes, based in community settings, aimed at improving CVD risk factors.

3.2. Methods

Methods for this systematic review followed the PRISMA guidelines and checklist. An assessment for the risk of bias of the studies in this review was not performed, although the standard of reporting and limitations are outlined in the discussion and synthesis of literature.

3.2.1. Eligibility

Inclusion Criteria

Criteria for inclusion of a study was: a structured exercise intervention assessing appropriate health outcomes related to CVD, such as; cardiorespiratory fitness, blood glucose variables, lipids, haemodynamic variables and body composition variables, were based in a public fitness centre or other public setting, had a sample cohort of adults aged at least 18 years, and studied healthy participants free from serious illness such as cancer, brain conditions and spinal surgeries or injuries which contraindicate PA. Articles were accepted which included persons with elevated CVD risk profiles, diabetics, obese or hypertensive individuals.

Exclusion Criteria

Articles were excluded which were not in English, if the intervention included a dietary intervention alongside exercise or if the intervention took place in any form of clinical research laboratory or University research facility. Articles were also excluded If the intervention consisted of only walking or behaviour change counselling, or if the participants were older adults (aged >65 years) or children (aged <18 years), or if they had or were recovering from any clinical conditions, brain or spinal injuries or other serious medical conditions.

3.2.2. Search Strategy

Search terms are presented in table 4. Searches were performed in the databases; PubMed, CINAHL and SPORTDiscus for articles published before December 2020. Titles and abstracts were read to assess the eligibility and papers were then read in full if necessary before being selected and included in the review or removed. Reference lists were examined for further eligible articles.

Table 4: Search strategy for PubMed/CINAHL/SPORTDiscus in Title/Abstract

#1
Cardiovascular Diseases[Mesh] OR cardiovascular risk factor* OR cardiovascular disease* OR obesity OR cholesterol OR cardiorespiratory fitness OR glucose OR blood pressure OR lipid*
#2
Fitness Centers[Mesh] OR Community Health Centers[Mesh] OR Fitness centre OR community health centre OR leisure centre OR community-based fitness centre OR leisure facility* OR community setting
#3
Exercise[Mesh] OR Exercise Therapy[Mesh] OR fitness training OR exercise intervention* OR combined exercise OR structured exercise OR exercise program* OR training program*
#4
#1 OR #2 OR #3

3.2.3. Selection Process

From the literature search, 11 articles were accepted for review which met the inclusion criteria. Searches of the reference lists of included studies revealed an additional nine studies, leading to a total of 20 studies selected for review (Figure 8).

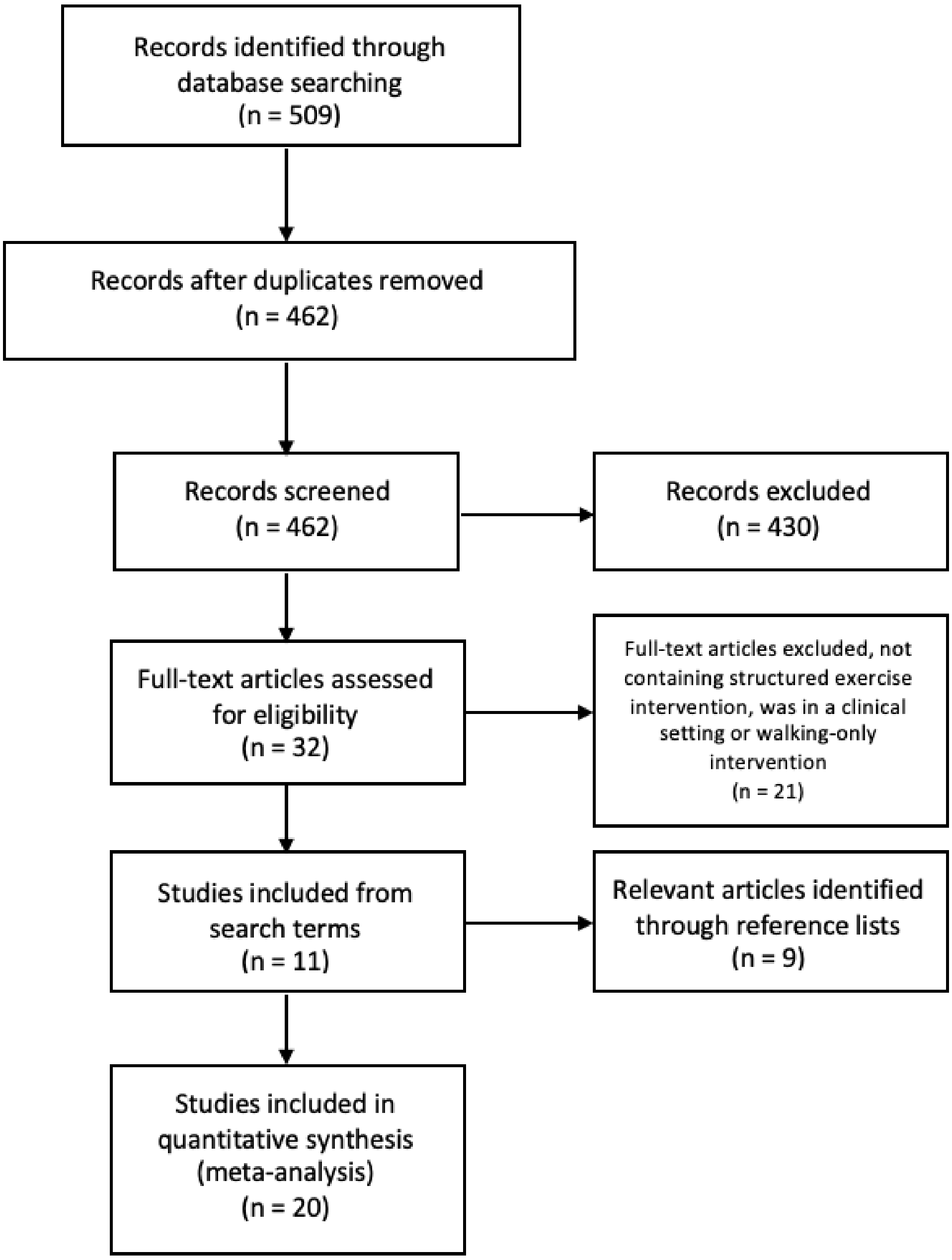

Figure 8: PRISMA Flow chart of literature selection

3.3. Results

The characteristics of included studies are displayed in table 5. Fourteen studies contained a supervised exercise programme, or some form of supervision, whilst five studies had no supervision support. Studies contained multiple outcome measures for CVD risk, including variables for body composition or anthropometry. Most frequently observed was weight and variables for blood pressure and indicators of blood glucose were reported in eight and seven studies, respectively. Impact of structured exercise on elements of the CVD profile was reported in seven studies.

3.3.1. Study Characteristics

The duration of interventions was between 10 weeks and one year, with follow-up of up to two years in the lifestyle prediabetes trial (Hays et al., 2016). In the reviewed studies, three sessions per week was the most common exercise frequency, and studies ranged from one to five sessions per week. Of the 20 studies, ten studies investigated the effects of a combined intervention of aerobic exercise and resistance training. Four studies investigated a single-mode aerobic exercise programme and three studies a resistance training programme. Other studies included lifestyle change interventions and PA targets which could be accomplished by performing various modes and types of exercise, and one intervention used a Les Mills cycling programme. Sample sizes within the included studies ranged from 21 to 559 participants (Valle et al., 2006, Birnie et al., 2016); two studies had more than 400 participants (Birnie et al., 2016, Graffagnino et al., 2006).

Many of the studies included for review did not define any completion requirements with the exercise interventions nor any obligation to attend a required amount of the intervention to be included in the final analyses. The study from Dunn et al. (1997) reported statistically significant improvements in the structured intervention across multiple risk factors; SBP, DBP, TC, LDL-C and BF%. Compliance in their study was high with 106 individuals completing the 6-month examination out of 114 who were initially randomised. Similarly, 137 participants of 156 were retained in the structured programmes by Teychenne et al. (2015). High retention was reported by Maddison et al. (2019) which observed 87.5% of participants completing all required assessments. The interventions from Dunn et al. (1997), Annesi and Gorjala (2010), Teychenne et al. (2015), Birnie et al. (2016), Maddison et al. (2019) included consideration of behaviour change models and theories such as Social Cognitive Theory (Bandura, 1986) and Stages of Motivational Readiness (Marcus et al., 1992a), in the design of the intervention either with discussion with professionals or counselling sessions. In contrast, the study by Mann et al. (2016) which was longer in duration, and one of the study's that did not consider any behavioural or motivational aspect, witnessed a retention of 32% at the end of the 48-week intervention, was unsupervised, and had an inclusion criteria of completing a certain amount of the prescribed sessions throughout the intervention.

3.3.2. Hypertension

The most frequently used variables for hypertension were systolic blood pressure and diastolic blood pressure. Two studies, Mann et al. (2016) and Møller et al. (2018), reported mean arterial pressure (MAP). Seven studies reported reductions, DBP reductions ranged from 2 to 19.5mmHg (Brehm et al., 2005, Dalleck et al., 2013, Dunn et al., 1997, Kreuzfeld et al., 2013, Mann et al., 2016, Møller et al., 2018, Seward et al., 2019). A reduction in DBP by 19.5mmHg and SBP by 19.83mmHg was observed in the study by Brehm et al. (2005), which lasted one year. No significant changes were reported for any hypertension variables by Maddison et al. (2019).

3.3.3. Lipids

From the articles included in this review, six included an outcome measure associated with the lipid profile, while two others assessed variables associated with inflammatory markers such as c-reactive protein and leptin (Miller et al., 2014, Wozniak et al., 2009). All six studies included an outcome measure of total cholesterol (TC), one of these studies did not report a significant change following a structured exercise programme (Mann et al., 2016). Improvements in LDL-C ranged from 2.4 to 26mg/dL, the largest change was observed in the study by Brehm et al. (2005) which had a one-year intervention period of combined exercise.

3.3.4. Body Composition

All studies except Mann et al. (2016) reported body composition outcomes, five reported no statistically significant changes to weight or BMI, and one reported no significant improvements in other outcomes (Valle et al., 2006). One of these five studies reported a significant improvement to waist circumference and body fat percentage (Maddison et al., 2019), and was the only study to consist of a structured combined exercise intervention. Body mass index was significantly improved in four studies (–0.3 to –1.62kg/m^2). Significant improvements in waist circumference were observed in six studies (between –0.9 to –4.9cm), five of which included resistance or strength training. Significant improvements in body composition were reported in studies lasting from 12 weeks to two years. The study by Valle et al. (2006) lasting 10 weeks did not produce any significant effects on body composition variables.

3.3.5. Blood Sugar

Six studies provided an outcome measure associated with blood sugar (Brehm et al., 2005, Dalleck et al., 2013, Dunstan et al., 2006, Graffagnino et al., 2006, Miller et al., 2014). The study by Brehm et al. (2005) reported the greatest change in fasting glucose (-17.25mg/dL) with an exercise intervention that lasted one year. The largest improvements in blood glucose observed in this study were in "high-risk" individuals which was significantly greater than the "low-risk" group. Two studies reporting an outcome associated with blood sugar were less than six months duration; and reported significant improvements to blood glucose, (Dalleck et al.; Male = -4.9%, women = -2.9% and Seward et al.; -2.8mg/dL). Four out of six studies consisted of a combined exercise intervention. The study from Dunstan et al. (2006), consisted of a resistance training-only exercise programme, and reported significant changes to fasting blood glucose, HbA1c and insulin. From the six studies that provided an outcome measure associated with blood sugar, three of them did include a dietary or nutritional counselling elements in the interventions.

3.3.6. Cardiorespiratory Fitness

Cardiorespiratory fitness in the form of maximal oxygen uptake (VO_2max) was significantly improved in all nine studies that reported an outcome (Campbell et al., 2009, Dalleck et al., 2013, Kreuzfeld et al., 2013, Maddison et al., 2019, Mann et al., 2016, Møller et al., 2018, Seward et al., 2019, Tworoger et al., 2003, Weatherwax et al., 2019). Eight of these studies reported VO_2max and Maddison et al. (2019) used a timed 4km cycle test procedure. Improvements in CRF were similar across all studies, and ranged from approximately +1.8 to + 3.6ml/kg/min^{-1}. The apparent large increase in VO_2max reported in Campbell by almost 14%, contained low baseline VO_2max levels, hence this corresponds to a change of 2.7ml/kg/min^{-1}. The study by Mann et al. (2016) did not initially report significant changes in their original analysis, significant improvements in CRF were only reported once the sample had been subject to reanalysis by splitting participants into high and low-fit groups by baseline VO_2max levels. Significant changes in low-fit participants in the structured exercise group were then observed. Six out of the eight studies performed maximal tests to determine CRF and two studies used sub-maximal procedures (Dalleck et al., 2013, Mann et al., 2016).

Table 5: Research articles based in public and community settings

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Annesi and Gorjala (2010), U.S.A	Pre-post	51 obese women	Regression models predicting change of BMI with mood, barriers self-efficacy, physical self-concept, body satisfaction	6-month moderate intensity aerobic exercise, 3 sessions per week plus nutrition information	YMCA, unsupervised, monthly one-to-one support meetings	Change in BMI, −1.62kg/m^2*; Regression models accounted for proportion of change in BMI*. Mood reported unique contribution to change in BMI*
Birnie et al. (2016), U.K	Pre-post	559 obese adults	Weight, BMI	12-week Weight Watchers & Exercise & behaviour change. Weekly sessions for all components	Community-based leisure centre, supervised	Weight −5.9kg; average % weight loss, 3.7%
Brehm et al. (2005) Germany	RCT	157 Sedentary adults	BP, TC, blood glucose and BMI	1 year, 20 mins moderate intensity AE, 40 mins strength & flexibility training, 1 session per week vs active and non-active controls. Intervention group divided into high, low and no risk	Sports Club, (supervision not specified)	High risk group: mean sig* reductions in SBP, −19.83mmhg; DBP, −19.50 mmhg; GLUC, −17.25mgdL^{-1}; TC, −37.88mgdL; LDL-C −26.12mgdL; TRIG, −114mgdL; BMI, −0.45kg/m^2*

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Campbell et al. (2009) Seattle, U.S.A	RCT	115 obese postmenopausal women	C-Reactive protein (CRP), Anthropometric values, VO_2max	12-months AE intervention, >45 min session, 5 days a week (60-75% max HR) vs CONT	Partially supervised, Set at research facility or home	Exercise group vs CONT: CRP, 2.15mg/L* vs 2.65mg/L; SAA, VO_2max 13.8%* vs 0.1%; weight −1.8kg* vs +0.3kg; BF%, −1.5%* vs +0.02%
Dalleck et al. (2013), U.S.A	Quasi-experimental	332 healthy adults	EE, Relative EE, WC, Body mass, SBP, DBP, TC, HDL-C, LDL-C TRIG, Blood glucose, VO_2max	14-week AE programme 3 sessions per week (mean intensity 42% VO_2max)	Community-based, supervised	Men: Change in EE, +226.4%*; Relative EE +211.1%*; WC, −1.6%*; Body mass, −0.8%*; SBP, −2.9%*; DBP, −2.1%*; TC, −0.3%; HDL-C, +7%*; LDL-C, −3.6%*; TRIG, −8.4%*; Blood glucose, −4.9%*; CRF, +10.3%*. Women: Change in EE, +191.3%*; Relative EE, +188.3%*; WC, −1.4%*; Body mass, −0.8%*; SBP, −2%*; DBP, −1.6%*; TC, −1.4%; HDL-C, +4.7%*; LDL-C, −2.7%*; TRIG, −6%*; Blood glucose, −2.9%*; CRF, +9.2%*

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Dunn et al. (1997) U.S.A	Quasi-experimental	235 Sedentary adults	Lipid, BP, Anthropometric values	6 Months structured AE + RT exercise programme Vs lifestyle PA counselling	Fitness Centre, supervised	Mean change STRUC vs LIFE: TC, −0.3 vs −0.2mmol*; LDL-C, −0.2 vs −0.1mmol*; SBP, −1.8 vs −3.2mmhg*; DBP, −2.2 vs −2.2mmhg*; %BF, −1.7% vs −1.4%*
Dunstan et al. (2006), Australia	Randomised trial	57 Overweight adults with diabetes	Glycemic control (HbA1c), blood glucose, Insulin sensitivity, weight, WC, fat mass, lean body mass	12 months Fitness centre vs home-based resistance training (2 sessions per week, progressive intensity) after a 2-month programme in exercise laboratory	Supervised in lab, unsupervised fitness centre, home	laboratory-programme HbA1c −0.4%*, increased LBM 0.7kg*. Fitness centre: HbA1c at 2 months –0.5%* and 14 months −0.4%*. Blood glucose at 14 months −0.8mmol/L*; Insulin, −5.4%*. Centre group 14 months: weight, −2kg*; WC, −2.9cm*; fat mass, −1.8kg*. Home group 14 months: weight, −1.8kg*; WC, −2.9cm*

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Graffagnino et al. (2006) U.S.A	Pre-post	418 overweight or obese adults	Anthropometric values, Blood glucose and lipid profile	6-month weight loss programme based on ACSM guidelines AE+RT	Community-based wellness centre and at-home, unsupervised, partial counselling and monitoring	Mean change: TC, −12.1mg/dL^{-1}*; LDL-C, −9.6mg/dL^{-1}*; HDL-C, +1.7mg/dL^{-1}*; TRIG, −21.7mg/dL^{-1}*; GLUC, −4.6mg/dL^{-1}*; weight, −0.6kg*
Hays et al. (2016) U.S.A	RCT	216 overweight adults with prediabetes	Weight	24-month follow-up, individual PA target (equivalent >150min per week of walking) to achieve moderate weight loss (5-7%) vs counselling control	YMCA, unsupervised	Weight, −3.61kg
Kreuzfeld et al. (2013) Germany	Pre-post	119 (healthy, baseline mean body mass of sample = overweight)	VO_2max, blood pressure, body composition	3-month group exercise, 2 sessions per week, endurance exercise and resistance training, Health competence enhancing lectures	Fitness centre, supervised	SBP, −5.33mmhg*; DBP, −5.07mmhg*, VO_2max, +1.75ml/kg^{-1}/min^{-1}*; BF, −0.6kg*; BF%, −0.6%*
Maddison et al. (2019) New Zealand	RCT	96 overweight men	Weight, WC, BF%, resting HR, SBP, DBP, CRF(4km cycle test, seconds), adherence to ≥3	12-week AE, body weight exercises, strength training and anaerobic training programme, 2 sessions per week,	Rugby club/fitness centre, supervised	Intervention vs control adjusted mean difference: weight, −2.5kg; WC, −3.5cm*; BF%, −1.8%; resting HR, −6.7beats per

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
			lifestyle behaviours	vs no intervention control		minute*; DBP, −4.2mmhg*; CRF, −26.2secs; ≥3 lifestyle behaviours, odds ratio 7.9*
Mann et al. (2016) U.K	Semi-randomised design	369 sedentary adults	MAP, VO_2max, TC	48-weeks PAC FREE COMB CONT	Unsupervised, Public fitness centres. Monthly meeting with FREE and PAC groups	STRUC: MAP, −2.5%*. VO_2max in low-fit participants: STRUC, +3.5%*; PAC, +3.3%*; FREE, +2.6%*. CONT: TC, −0.8%*
Miller et al. (2014), U.S.A	RCT	Sub-sample of 30 obese adults from previous trial	Weight, BMI, CRP, IL, ADP, PAI, TNF, L	2-year lifestyle weight loss (weekly sessions, PA goal 180m/week + 5-7% weight loss goal,) vs usual care	Community-based sites, group sessions, supervised	Lifestyle weight loss: Weight, −7.8%*; ADP, +2735.8ng/ml*; L, −3.7pg/ml*; CRP, −0.1mg/dL; TNF, −0.8pg/ml; IL, −0.1pg/ml*; PAI, −13pg/ml*
Minges et al. (2011) Australia	RCT	86 adults at risk of developing type 2 diabetes	WC, upper and lower body strength and agility	24-week resistance training programme 2-3 sessions per week	Community fitness centre, supervised in groups	WC, −4.9cm*; Lower body strength +4.2reps/30s*; Upper body strength, +5.3reps/30s*; agility, −1.2s*

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Møller et al. (2018) Denmark	Quasi-experimental	68 Sedentary men with lifestyle diseases	SBP, DBP, MAP, weight, BMI, LBM, BF, BF%, VO_2max	12-16 weeks, 2 sessions per week, Fitness training (50-80%maxHR, AE + strength training) vs team-sport (75% maxHR	Community health centre, Supervised by physiotherapists	Team: DBP, −2mmhg; SBP, −7mmhg* vs fitness training; weight, −1.4%*; fat mass, −2.2%*. Fitness training: VO_2max, +1.8ml/min/kg; weight, −1.6%*; BF, −3.5%*; BF%, −2.3%*
Seward et al. (2019) U.S.A	RCT	150 Inactive adults	Body mass, WC, SBP, DBP, TC, HDL-C, LDL-C, TRIG, GLUC, VO_2max, MetS z-score	12 weeks, 3 sessions per week, progressive AE and muscular exercises based on American Council on Exercise Integrated Fitness Training models guidelines vs inactive control	Community-based, Supervised	Intervention: Body mass, −0.6kg*; WC, −0.9cm*; SBP, −5.2mmhg*; DBP, −2.4mmhg*; TC, −2.4mg/dL; HDL-C, +3.6mg/dL*; LDL-C, −6.6mg/dL; TRIG, −6.3mg/dL*; GLUC, −2.8mg/dL*; VO_2max, +3.6ml/kg/min*; MetS z-score, +0.6*
Teychenne et al. (2015), Australia	RCT	318 adults with type 2 diabetes or overweight or obese	HbA1c, muscle strength, Weight, BMI	6-month standard strength training (3 sessions per week for 6 months) vs enhanced strength training (plus counselling), followed by 6-month maintenance phase	60% supervised, community fitness centre	Enhanced strength training: 6-month: HbA1c, −0.13%*; Mean net difference for change between groups: Weight, −1kg*; BMI, $-0.4kg/m^2$*; HbA1c, −0.17%*

Author/Year/ Country	Study Type	Sample Size & Characteristics	Outcome Measures	Intervention	Setting/ Supervision	Effect
Tworoger et al. (2003) Seattle, U.S.A	Quasi-experimental	173 Sedentary, postmenopausal, obese or overweight women	VO_2max, BMI	1 Year moderate-intensity exercise (45 mins AE 60-75% MaxHR & 10 mins weight training, 5 days per week) vs low intensity stretching	Fitness centre and home-based, partially supervised	VO_2max, +12%*; BMI −0.3kg/m^2*
Valle et al. (2006) Brazil	Quasi-experimental	21 Healthy females	Weight, body fat, BF%, lean weight, lean mass index	10 weeks Les Mills indoor cycling programme, 2 sessions per week vs 3 sessions per week	Fitness centre, supervised	No sig* effects on any outcomes within or between groups
Weatherwax et al. (2019) New Zealand	RCT	47 Sedentary adults	VO_2max, PA, BMI, Weight	12 weeks, 3 sessions per week, standardised vs individualised aerobic exercise programmes vs control	Fitness facility, (supervision not-specified)	Individualised – Pre-post: weight, −0.7kg; PA, +2918MET.min.wk^{-1}*; VO_2max, +3.3ml/kg/min*: Vs CONT: Standardised - pre-post: PA, +2829MET.min.wk^{-1}*; VO_2max, +1.7ml/kg/min*

Abbreviations undefined within table: MAP=Mean arterial pressure; VO_2max=maximal oxygen consumption; TC=total cholesterol; PAC=physical activity counselling; FREE=free use of facilities; STRUC=structured exercise programme; CONT=control group; LIFE=Lifestyle counselling intervention; Sig*=statistically significant (p<0.05); HR=heart rate; SBP=systolic blood pressure; DBP=diastolic blood pressure; HIIT=high intensity interval training; CRF=cardiorespiratory fitness; WC=waist circumference; LDL-C=low-density lipoprotein; HDL-C=high-density lipoprotein; MICT=moderate intensity continuous training; RCT=randomised control trial; SD=standard deviation; AE=aerobic exercise; RT=resistance training; BMI=body mass index; LBM=lean body mass; TG=triglycerides; GLUC=mean fasting blood glucose; BF%=body fat percentage; EE=energy expenditure; PA=physical activity; BP=blood pressure; ADP=Adiponectin; IL=interleukin 6; L=leptin; CRP=c-reactive protein; TNF=tumor necrosis factor α; PAI=plasminogen activator alpha; MET=metabolic equivalent; HRR=heart rate reserve; HbA1c=glycated haemoglobin; mmhg=millimetres of mercury; N=Newton

3.4. Discussion

3.4.1. Summary

Firstly, the systematic review reported just 20 studies included for review suggesting a paucity of research investigating PA and exercise improving CVD risk factors, set in community-based settings. Most studies used participants with elevated risk profiles at baseline. Sample sizes within the literature were quite small, which can affect statistical power and leave questions surrounding how the intervention will be received when scaled up as a public health intervention. Questions remain on the overall impact public fitness centres have in regards to engagement and impact on public health indicators such as CVD risk factors. Almost all studies reported a positive impact on elements of the CVD risk profile. Most often studies used supervised combined exercise programmes of aerobic exercise and strength or resistance training, and lasted 6 months or less.

The standard of reporting within these studies was quite low; two studies included in this review did not specify whether the exercise interventions were supervised, and others did not specify the exact location where the exercise programmes took place. Similar issues with the quality of reporting were also outlined in a review by Ashton et al. (2018) of resistance training programmes.

A common theme throughout the discussion are the differences in baseline levels of risk factors of participants, and differing programme characteristics. However, once scaled up as a public health intervention, participants will likely be of varying risk status and therefore this reviews allows us to understand how different members of the public may react to the various training stimulus with regards to improving risk factors. From this literature review, it is challenging to recommend a definitive intensity, frequency and duration of exercise, which would challenge current recommendations. It could be suggested from this review that overall training volume is the best indicator of changes to multiple CVD risk factors rather than the specific mode, intensity or duration. Therefore, this advocates for a life-long approach to a physically active lifestyle which includes exercise (Boutcher and Boutcher, 2017).

3.4.2. Adherence and retention to Community-based Exercise

Adherence is defined as the number of sessions attended, divided by the number of sessions prescribed. Retention is merely the number of participants who complete follow-up testing, hence this does not necessarily mean adherence to all prescribed sessions (Cyarto et al., 2006). The results from this review, may suggest that the inclusion of a behavioural change element or consideration of motivational factors provide a greater influence on the retention of participants in community-based interventions. Including a behaviour change element is supported by the comparison of three 6-month studies included for this review. Minges et al. (2011) and Dunn et al. (1997), were both supervised and reported retention rates of 37% and 93%, respectively, with the latter study having included consideration of social cognitive theory in their approach. There are insufficient similarities between studies in this review to examine the specific impact of a behaviour change or social cognitive approach, particularly in long-term studies. Moreover, the study from Møller et al. (2018) reported a retention of around 69% without a behaviour change intervention, although reasons for drop-out were not reported. In the general population, adherence to the recommended aerobic PA guidelines is between 54-65% (Office of Disease Prevention and Health Promotion, 2020, Piercy, 2019). Due to the ambiguity surrounding the adherence requirements in studies for participants to be included in final analyses, a universally accepted clarity in the nomenclature of adherence to interventions on exercise studies is required, as well as more information and transparency in the methods regarding attendance, compliance and retention.

3.4.3. Community-based Exercise and Hypertension

The study from Brehm et al. (2005) reported the greatest reductions in multiple risk factors; –19.5mmHg DBP and –19.83mmHg SBP, using one session per week, in a year-long intervention. However, it is likely their participants had taken up PA alongside this intervention as this was the purpose of the programme; to act as a “minimum programme” and to change attitudes. Hence, the results report that PA levels were increased and participation in “other settings”. Further, individuals whose participation was less than 60% were regarded as drop-outs. Therefore, those included in final analyses had high participation in the programme, which likely contributed to a large change in hypertension values. Their findings have clinical relevance representing a reduction in diagnosis from hypertension grade 2 to a ‘high-normal’ classification in the European (ESC/ESH) guidelines from Williams et al. (2018).

Small reductions in SBP and DBP of 3mmHg can also reduce the risk of stroke and heart disease by 5% and 8%, respectively. Reductions of 3mmHg were achieved by all studies in this review (Bundy et al., 2017, Chobanian et al., 2003). Systolic blood pressure is more difficult to control than DBP (Basile, 2002), and better predicts risk of CVD (Kannel et al., 1969). Previous research has suggested that a reduction in SBP of 20mmHg and to less than 160mmHg results in a 35-40% reduction in stroke and 50% reduction in heart failure (Franse et al., 2000). This scale of reduction was almost achieved by Brehm et al. (2005) but not by other studies in this review. This may reinforce the recommendation of exercise programmes as part of a long-term lifestyle habit, to provide clinically beneficial outcomes in blood pressure values and CVD risk (Ozemek et al., 2018, Shibata et al., 2018). A longer intervention duration and the elevated baseline blood pressure levels may account for the considerably greater improvement in DBP, which has been previously reported (Unick et al., 2011, Reljic et al., 2018).

Training intensities ranged from 42% to 85% VO_2max, although there is no distinct differences between the hypertension outcomes of the studies and the varying intensity, which is consistent with a previous review (Costa et al., 2018). It should be noted that the participants exercising at 42% VO_2max were healthy adults (Dalleck et al., 2013). Other samples consisted of pre- or established hypertensive participants at baseline and performed greater intensity exercise. This relationship has been shown to affect blood pressure responses amongst other risk factors (Costa et al., 2018).

3.4.4. Community-based Exercise and Lipids

A reduction of 1mmol/L (38mg/dL) can reduce the risk of stroke by 16% (Wang et al., 2016). The study from Brehm et al. (2005) produced the largest beneficial impact to LDL, (–26mg/dL). Of the six studies, five consisted of a combined exercise programme, four studies produced significant improvements to the lipid profile (Theodorou et al., 2016, Mann et al., 2016). These findings are supported by a review from Mann et al. (2014) and controlled experiments by Canuto et al. (2012) and Ha and So (2012). The study from Dalleck et al. (2013) used an exercise programme of only aerobic exercise and did not report significant improvements in total cholesterol, compared with four studies in this review which did, by using a combined exercise programme (Brehm et al., 2005, Dunn et al., 1997, Graffagnino et al., 2006, Seward et al., 2019). Supporting this review, it was concluded that combined exercise modalities enhanced effects on the lipid profile further than aerobic exercise or resistance training alone, as separately, the modalities are more successful at reducing other specific risk factors (Mann et al., 2014). Aerobic exercise of a higher intensity is more effective than moderate PA in regards to the lipid profile as this commences the clearance of plasma LDL-C and cholesterol. Although, the study from Dalleck et al. (2013) had an average intensity of 42% VO_2max and was still able to produce significant improvements in LDL-C, suggesting overall training volume impacts changes to the lipid profile.

The evidence between exercise intensity and improvements in the lipid profile are inconsistent and further evidence is required for more precise recommendations (Tambalis et al., 2009). Low-moderate intensity exercise can be sufficient to improve elements of the lipid profile for most populations. This review supports previous reports suggesting that shorter studies should have a higher exercise intensity to produce significant effects on lipids (Kraus et al., 2002, O'Donovan et al., 2005, Wood et al., 2019).

3.4.5. Community-based Exercise and Body Composition

The significant changes to BMI reported in studies in this review all had participants which were either overweight or obese at baseline, which likely implicates the scale of improvements possible from the exercise programmes compared with healthy participants (Finkler et al., 2012). Whilst it may be difficult to suggest the specific clinical significance of the improvements found in the reviewed studies, a longitudinal study has previously found a one unit increase in BMI is associated with a 6% increased risk of stroke in men. Hence decreases in BMI, particularly below the 30kg/m^2, are likely to decrease the risk of strokes, and other cardiovascular conditions (Kurth et al., 2002, Larsson et al., 2020). The study from Annesi and Gorjala (2010) reported the greatest improvement and included theory-based psychological factors to predict weight loss. As previously mentioned, this may also contribute to an increased adherence to the intervention. However, their study had the smallest sample size (51), and was the only study to use solely obese women.

The clinical relevance of improvements of <1cm in WC are not well reported in the literature. However, previous studies have indicated small reductions to WC are associated with improvements of components of metabolic syndrome (Shen et al., 2006). The current review is supported by findings from Schroeder et al. (2019) which reported significant reductions in WC (mean = 1.7cm, 95% CI's: –3.3, –0.1) in similar populations. A meta-analysis has shown that aerobic exercise programmes are also effective at reducing WC by similar margins; (WC, –2.18 cm (95% CI 3.75, 0.62), in randomised controlled trials (Lemes et al., 2018). Reductions in WC may provide evidence that results from lab-based studies can be replicated in more natural exercising environments like public fitness centres.

Further, combined exercise programmes have been shown to have similar positive effects on body composition (body weight, –1.6kg) when compared with resistance training programmes in controlled settings (Ho et al., 2012). However, endurance exercise has been regarded as the most effective in regards to weight loss (Dumortier et al., 2003). It is suggested this is mainly due to the total energy expenditure, and even with a low intensity programme (30-60% theoretical maximal power on a cycle ergometer) has been shown to be effective (–2.6kg). It is further supported by three studies in the present review showing that aerobic exercise groups reported significant changes in body composition (Annesi and Gorjala, 2010, Campbell et al., 2009, Dalleck et al., 2013). Whether these differences are significantly different from combined exercise interventions is unclear, suggesting a need for more studies examining combined programmes on body composition (Wewege et al., 2018).

3.4.6. Community-based Exercise and Blood Sugar

It is suggested from the studies in this review that the resistance training component of a combined exercise intervention is important in improving blood glucose parameters. For larger magnitude improvements, a longer intervention duration is necessary, with a larger overall training volume. Although, due to the very few studies found in the literature within real-world settings, more studies are necessary as well as investigations of a longer duration.

Dietary or nutritional counselling has been described as a central component to managing blood glucose levels (Colberg et al., 2010). Hence, diet could have affected the outcome on blood sugar variables within the three studies which used them in this review. However, a previous review on exercise in type 2 diabetics reported that the effects of a diet plus exercise intervention produced similar effects to HbA1c, as exercise-only interventions (Boulé et al., 2001). This is consistent with the findings from the current review. Dunstan et al. (2006) proposes that those with a greater baseline level of CVD risk, such as diabetics and overweight individuals, will achieve greater reductions in blood glucose levels (−14mg/dL). Reviews of controlled trials comparing HIIT with moderate intensity exercise have shown mixed findings regarding outcomes in blood glucose.

3.4.7. Community-based Exercise and Cardiorespiratory Fitness

The study from Mann et al. (2016) did not initially report significant changes to VO_2 max, this was potentially due to the participants baseline fitness levels (102 out of 369 participants reported baseline fitness levels of >40ml/kg/min). This review may suggest that a combined exercise intervention lasting 12 weeks and 2-3 sessions per week is sufficient to produce significant improvements in VO_2max in community settings. Longer duration studies, such as those lasting 1-year (Campbell et al., 2009, Mann et al., 2016, Tworoger et al., 2003) do not appear to significantly affect the change in VO_2max compared with shorter duration studies. A lack of change in VO_2max could be due to the varying baseline fitness levels between studies or the training intensity in shorter duration studies (Møller et al., 2018, Seward et al., 2019, Weatherwax et al., 2019). of Further investigations are required in long-term combined exercise interventions in public settings to substantiate this.

3.4.8. CVD Risk Assessment Tools

Two studies in the current review used the Framingham Risk Score (Dalleck et al., 2013, Dunn et al., 1997), which is a tool that estimates the 10-year risk of CVD using an algorithm that considers age, gender, smoking status, diabetes, dyslipidemia and blood pressure (D'Agostino Sr et al., 2013, Kannel et al., 1976). The study by Dunn et al. (1997) observed a significant reduction in the Framingham Risk Score of −6.8 predicted CVD events per 10,000 person-years, whereas using a slightly different unit of measurement, the study by Dalleck et al. (2013) also reported a significant reduction of −0.8% in men and −0.2% in women. Despite only two studies in the current review using this tool, it is perhaps a useful inclusion in future investigations as it can be used in large scale studies, and provides a clinically relevant and easily understood outcome. It also contributes to the persons' self-awareness and knowledge of ones' health with regards to their CVD profile. Tools with multi-variable risk assessment also prevents over-emphasis on isolated risk factors, which have been suggested to overestimate the population-attributable risks (Chang et al., 2001), and instead considers the risk profile as a whole.

3.5. Recommendations

Further interventions aimed at sustained changes to lifestyle and include combined exercise modalities, including aerobic exercise and resistance training to benefit the wider CVD risk profile are recommended from this review. More focus investigating unsupervised exercise behaviour of public fitness centre members is required, which are not commonly used in the literature and yet provide a good indication of exercise in public health settings.

Future investigations in community settings should aim to obtain larger sample sizes, as these will more closely replicate a public health intervention and provide insight into the effectiveness of exercise programmes once they have been scaled-up. Investigations are needed into healthy participants or those with lower-risk profiles at baseline, as this is not prevalent in the literature. From this literature review it is not well understood whether members of public fitness centres have high or low-risk CVD profiles, which was shown in this review to affect the magnitude of change on CVD risk factors from exercise interventions.

There is considerable opportunity for research studies to provide information regarding attendance of sessions within exercise programmes, as well as an obligation to complete a required amount to be included in final analyses. For example the TIDieR guidelines for reporting interventions, specifically items 8, 11 and 12, would provide sufficient information for synthesis of these elements of interventions (Hoffmann et al., 2014). Follow-up procedures are lacking in the literature; reporting reasons for drop-out is also generally lacking in the reviewed studies, which could be insightful to improve the retention of future studies. Future interventions should include non-supervised exercise training as it is unlikely that those exercising in real-world settings will be supervised for all of their training sessions. It is possible that the supervisors in these studies provided motivation for participants, and affected the results (Schmidt et al., 2019).

Considering that many reports have outlined the issue of CVD across Europe, only five studies in this review were based in Europe. Hence, future studies are required, investigating this population (Bilal et al., 2016). Community based interventions represent an ideal population to test in ecologically valid settings. It would be beneficial to use comparison groups which include active groups as well as non-exercising controls. Comparator groups only occurred in three studies in the present review (Dunn et al., 1997, Graffagnino et al., 2006, Mann et al., 2016), but would help in understanding the effectiveness of “usual” exercising behaviour at reducing CVD risk, or if structured exercise programmes are the most effective.

3.6. Limitations

The quality of reporting in some of the studies included in the current review can be described as quite low, particularly regarding the depth and details of reporting methods. It is recognised that a risk of bias assessment was not performed for this review. However, due to the large heterogeneity of the outcome measures, the varying quality of reporting and the specific search criteria, it is expected that the bias be moderate-low. The discussion section also recognises the limitations of each individual study, though it is understood there is a chance of publication bias, as journals may lean toward publishing studies which have positive and potential impactful results which has been previously reported (Murad et al., 2018). It is possible that some literature may have not been identified from the search terms due to the language limitation, such as studies investigating Spanish populations. Although, most notable European journals publish in English.

3.7. Conclusion

Public fitness centres have the potential to be a suitable environment for PA promotion, though further public-based investigations are necessary. Fitness centre members' PA behaviour is not currently well investigated. Learning about this populations' CVD risk and exercise behaviour, in comparison with the general population, will provide insight to the impact of fitness centres in reducing the prevalence and burden of physical inactivity and CVD.

The review outlined that interventions set in community or public-based settings are scarce in the literature. It is recommended that combined exercise interventions were an effective treatment at improving multiple CVD risk factors. This review highlighted a significant lack of research away from laboratories, with only 20 studies being included in the review, compared with the vast amount of studies set in tightly controlled environments. We rely on lab-based studies to investigate the cause and effect relationship from interventions which are successful in specific populations, though these are comparatively different to a "typical" exercising environment. An indication of this issue is evident when comparing the adherence and retention rates of lab-based interventions (often 100%), with exercise programmes set in public fitness centres like in this review, (often below 50%) (Mann et al., 2016). Retention rates suggest similarities between the behaviour of participants in these studies and public fitness centre members, who seldom have high attendance rates (≥ 3 visit per week) (IHRSA, 2020). It has been proposed that for the research in this area to progress to meaningful and impactful application, more large sample trials which maximise generalisability and ecological validity are required, as well as consideration and application of behavioural sciences, satisfying both the scientific principles and process evaluation which is important to stakeholders and commissioners of public health initiatives (Beedie et al., 2015).

High-intensity programmes although not frequent in this literature review, are successful in risk-reduction in shorter interventions, and if this intensity is sacrificed, a longer intervention duration should be considered to sustain significant positive changes to CVD risk. However, the most impactful intervention is a life-long approach to PA or exercise with a sustainable long-term programme (high training volume), and is the most beneficial for reducing overall CVD risk. A behaviour-change element or motivation-focused aspect such as counselling sessions appear to improve adherence to public-based exercise interventions.

This review provides evidence that to examine the effectiveness from a public health perspective, we must investigate if these interventions can be scaled up, for the wider population in public settings (Indig et al., 2018). Furthermore, the effectiveness of unsupervised, combined exercise interventions and in a public health or community-based setting, requires further exploration and analysis, to examine a range of CVD risk factors, providing greater validity as a public health intervention. Investigating the populations that currently utilise these services will provide a better understanding of the PA behaviour and CVD risk factors and lifestyle of fitness centre members compared with the general populations.

Chapter 4.

Comparative Analysis of PA Behaviour Between Public Fitness Centre Members and the General Population

4.1. Introduction

In chapter 2 it was established that CVD is a public health concern in Europe and in particular, Spain. This is largely due to modifiable CVD risk factors associated with lifestyle, such as physical inactivity. Previous reports showed that PA levels in Europe are low, sedentary behaviour is prevalent, and that both of these contribute to the worsening healthcare and economic burden in Spain. Chapter 3 provided evidence of a paucity of research set in public or community-based settings such as public fitness centres, though postulated that the participants in real world studies may have similar exercise behaviour as fitness centre members.

Physical activity participation is a complex behaviour, which is influenced by demographic, environmental and socioeconomic factors (Bauman et al., 2002). In previous reports, the general populations of Europe and Spain were shown to be “insufficiently active” (Martín-Borràs et al., 2018). However, research has also shown that across different regions of Spain, PA levels vary and thus barriers and facilitators likely differ between communities (Mielgo-Ayuso et al., 2016). Hence, surveying fitness centre membership across various geographical locations is important when describing the population. This information may help to facilitate more individualised public health initiatives to increase engagement in PA and active lifestyles.

Interventions to increase PA behaviour have been tested in many different settings. Currently, in relation to structured facility-based interventions, there is a lack of research conducted in settings which are representative of real-world exercise environments such as community-based, or public, fitness centres. Despite the many proven benefits of tightly controlled laboratory-based exercise training, there are significant challenges in implementing these protocols in real-world public health interventions (Mann, 2014). Similar challenges are also true for behavioural research which focuses on the effects of an intervention in a specific and often small sample of individuals (e.g. older adults, obesity, diabetes or CVD), rather than the general population, thus limiting external validity (Dzewaltowski et al., 2004).

Investigations drawing comparisons between general populations of multiple nations rely on the collection of data on a large scale. Survey data is important for assessing public health and designing nation-wide health improvement initiatives. These data can be compared to other nations to highlight the success of public health initiatives, such as those aimed at reducing inactivity (WHO, 2019). The Special Eurobarometer for Sport and Physical Activity is a report, requested by the European Commission, Directorate-General for Education, Youth, Sport and Culture and coordinated by the Directorate-General for communication. The report surveys all 28 member states of the EU (prior to Britain's withdrawal), and contributes data to support the developing policy framework for promoting sport and PA (European Opinion Research Group, 2018). Regular reporting on large populations allows researchers to deliver trend analysis comparing member states with each other as well as with previous years. These data can also provide a suitable comparison for other populations such as fitness centre members with regards to PA levels and demographic and socioeconomic factors.

The gap in research investigating CVD and exercise in settings which are a more natural exercising environment can be somewhat addressed using fitness centres and their members. Fernández et al. (2021) investigate the population of a Spanish fitness centre regarding PA levels considering age and gender, in comparison with the general population. Fitness centre members reported a greater prevalence of performing high levels of PA compared with the general population of Spain. However, we do not know how this compared to the rest of Europe. Investigating this can provide insight into the PA behaviour of Spanish fitness centre members compared with the European average. Further, investigating demographic, socioeconomic and motivations for exercise and PA behaviour, will identify the characteristics of the most active members of this population. This study will investigate PA levels using the same data sets obtained by Fernández et al. (2021), building on their study with further analysis to the rest of Europe and investigate sedentariness, motives and other PA behaviour related to the fitness centre.

It has been suggested by Daley and Huffen (2003) that fitness centres may provide a viable opportunity to overcome the issues associated with laboratory-based research. Fitness centres provide a real-world environment in which exercise is comparatively unsupervised and undertaken by a diverse population. However it is recognised that some challenges still exist with regards to fitness centre members not being entirely representative of the general population. Hence, accessing public fitness centre member data, and investigating characteristics and demographics in relation to the wider scope of the general population of Europe, will provide insight into who utilises public fitness centres and how populations engage with these facilities.

Based on previous reports, it is assumed that PA levels within public fitness centre members are greater than that of non-members or the average of the general population (Kaphingst et al., 2007, Ready et al., 2005, Schroeder et al., 2017). However, this has not yet been investigated in Spain and it is not known how much more active public fitness centre members are, and whether the difference is of any clinical significance with regards to health and wellbeing. Hence, this must be investigated in a population of Spanish fitness centre members. Analysing PA levels in different populations, will provide an insight into the factors associated with PA, such as socio-economic and lifestyle determinants. These comparisons are yet to be performed in a large sample, or in recent years, which is important when considering contemporary work, lifestyle and PA behaviour in Europe (Rodulfo, 2019).

Chapter 2 outlined the concepts and models associated with behavioural constructs of engaging in exercise. It also highlighted the importance of understanding motivation when considering the design of interventions aimed at behaviour change. Motivation has been the focus of many research articles and has been well-reported as a key indicator of exercise programme uptake, persistence and maintenance (Vallerand, 2007, Kim and Cho, 2013, Kang et al., 2020). The majority of motivation research in PA aligns with the social-cognitive approach whereby the human assumes an active role in decision-making and in planning achievement behaviour (Nicholls, 1989). Different motivations can affect members’ reasons for attending the fitness centre; for example to achieve extrinsic or intrinsic goals, such as improved physical fitness, to be selected for a sports team, to improve physical appearance, or to improve health for a sense of personal well-being.

Understanding motivation to exercise can aide prescription and promote individualisation and specificity. For example, demonstrating the value of outcomes from exercise, or providing a time-efficient solutions to meet the demands and time-constraints of a particular individual (Teixeira et al., 2012). Motivational and behavioural determinants of exercise may differ between demographics whether that be gender, age, geographical region, education or employment status. Consideration of all of this information will help to inform individualised interventions (Sherwood and Jeffery, 2000). Further, this information can help determine whether the person's motivation for exercise or PA, currently corresponds to their usual exercise behaviour. For example, if an individual's main reason for exercising is weight management, but the correct PA to influence that, is not currently being performed, then this would indicate a need to expand knowledge. Furthermore, observing this populations' reasons for exercise, and comparing them with the general population or less active individuals, may also explain the differences in PA levels between fitness centre members and the general population. These factors are important for the design of public health interventions, particularly regarding uptake and sustained behaviour change.

4.1.1. Aims

The aim of this chapter are two-fold; 1) to describe the sociodemographic characteristics and physical activity behaviour of public fitness centre members, and compare this with the general populations of Spain and Europe using data collected as part of the Eurobarometer surveys; and 2) to describe the prevalence of various motives for engaging in PA and the relationship of these motives with exercise and physical activity behaviour.

4.2. Methods

4.2.1. Participants

GO fit Members

Email invitations containing the survey were sent to 127,514 available addresses which were connected to members aged 16 years or older (total members approximately 200,000 and number of total accounts 158,606, including partner and family accounts). In the cases of couple or family memberships, the lead correspondent was asked to complete the survey as an individual. The email contained a link to ShopperTec's online platform. The survey is administered by GO fit annually to inform GO fit on their members and their engagement with the centre, as well as provide more in-depth information regarding the demographic characteristics of their members. The survey consisted of 68 items (Appendix 9.2), some with multiple sections, containing perceptions of the fitness centre such as value for money, as well as questions regarding PA and exercise behaviour, motives and sedentary behaviour. The outcome measures for the purpose of the studies in the following chapters were the demographic characteristics of members, direct measures of PA such as fitness centre visits and visit duration, and self-reported measures of PA such as IPAQ, group exercise classes attended and sitting time. Motives or main objective for exercising was also included as an outcome measure.

Eurobarometer (EU28) and Spain

For the purpose of the first empirical study in this thesis, a set of data from the wider population of Spain and Europe, was retrieved from a public repository. The European Commission conducts public opinion polls across all EU member states, for the purpose of this project the Special Eurobarometer on Sport and Physical Activity 472 was used (European Opinion Research Group, 2018). The report from 2018 contains the data of 28 EU member states (n = 28,031), prior to Britain's withdrawal from the EU. The data from Spain (n = 1,002) was separated from the report for a closer comparison with the fitness centre members in the study. The data collection was conducted in 2018, at a similar time to the GO fit survey. This used a multi-stage random sampling design and is therefore representative of the regions in regards to population size and density. This method of survey uses face-to-face interviews in the participant's native language.

4.2.2. Study Design

This study was a retrospective comparative analysis of secondary data of PA behaviours and demographic characteristics of fitness centre members and the general population. For the data from fitness centre members, 158, 606 unique email accounts were identified from all GO fit fitness centres. Of these, 127,514 were recognised as active and were sent an email invitation to complete a survey, and given a two-week period in June 2018, to respond. They were also sent a participant information sheet (Appendix 9.3) outlining the details of the project, and an informed consent, outlining that their participation is voluntary and their right to withdraw data at any point. Data were also obtained from the Eurobarometer (European Opinion Research Group, 2018) for the general populations of Europe and presented as “EU28” alongside data from Spain, available to download from the EU Open Data Portal (https://data.europa.eu/euodp/en/data/dataset/S2164_88_4_472_ENG).

4.2.3. GO fit Survey

The survey was conducted by the GO fit partner ShopperTec using an online platform, throughout June 2018. Email invitations were sent to all identified members with a follow up email to members whom had not responded one week after the initial email invitation. Anomalous results or occurrences where the researchers suspected an error, were followed up with the participant by email. If no reply was received, a collective decision was made on the accuracy of the participant’s data. For example, if a participant’s physical activity exceeded what was expected, (e.g. 130,000 MET.mins.wk^{-1}) exclusions were made on a case by case basis. During the screening and data cleaning processes, these responses were excluded from analysis, assuming they were not a true reflection of PA levels or that mistakes were made in the response process. For responses to the questions in the IPAQ regarding sitting time, any which indicated a sitting time that exceeded the number of minutes in one day (1,440 minutes) were removed. The original survey was administered in Spanish for all members and the responses were then translated into English by the lead researcher.

4.2.4. Survey Questions for Fitness Centre Members

The survey (Appendix 9.2) included many items, but for the purpose of the current study the responses of interest were;

- Seven questions regarding personal characteristics: sex, age, fitness centre location, employment status, education level, civil status, household monthly income.
- Seven questions from the IPAQ relating to general PA and sitting time.
- Seven questions relating to fitness centre PA behaviour.

- One question about motives.

Demographic Characteristics

Education level was categorised in accordance with the education system in Spain. Primary and secondary schools exists similarly as they do in the UK. Vocational level training is regarded as the third level of education, comparable to the college and sixth form years of education in the UK which is the first non-compulsory stage of education. Civil status was categorised as; married, single, in a relationship (which was shortened to “in relationship”), divorced or widow. Income level was divided into categories and represents the members’ household monthly income.

4.2.5. Direct Measures of PA Behaviour in Fitness Centre Members

All fitness centre members had access to a mobile application which gives details regarding their workouts. Workouts and progress were accessed via a wireless connection to a “key” used to access each centre and connects to each Technogym® piece of equipment. Data recording required a check-in and check-out for each session using a station at the gym, which then updated the users profile via cloud technology. This information was updated and stored on a centralised system, to which the research team had access, thus enabling them to track members’ visits to the centres as well as some of the activity being undertaken in the gym. Thus, details regarding members visits such as number of visits and visit duration was updated automatically using this system, as well as the number of group exercise classes a member has attended. For the purpose of the current data collection, the following data were retrieved; fitness centre visits, visit duration and group exercise class attendance. These variables were placed alongside the self-report data from the survey, to create one database of results.

4.2.6. Self-Reported Measures of PA and Exercise Behaviours

The email invitation included a link to an online survey which was produced and administered by ShopperTec. Questions included; the International Physical Activity Questionnaire short form (IPAQ), as well as questions regarding their usual visiting behaviour, exercising behaviour and demographics (Appendix 9.2, 9.4). The survey also captured members’ PA conducted outside the fitness centre as well as number of visits to the centre in a given month, and visit duration. The IPAQ short form consists of 7 items, regarding moderate and vigorous PA, walking and time spent sitting for the previous seven days. MET minutes per week (MET.Mins.Wk^{-1}) was calculated by the formula provided by the IPAQ short form guidelines (Sjostrom et al., 2005). MET values for walking (3.3), moderate intensity PA (4) and vigorous intensity PA (8), are multiplied each by the relevant number of minutes per day and days per week. The questionnaire used was in Spanish, although for the purpose of this thesis the English version has been attached in Appendix 9.4. The repeatability of the Short Form IPAQ has been previously reported to be acceptable by Craig et al. (2003), and the measurement properties as, at least as good as other established self-reports.

For the comparison of PA level data with GO fit members and the Eurobarometer data, a truncation of data was performed. The Eurobarometer used a categorical response process for the collection of PA levels rather than an open solution for the participant to enter their PA time. The possible responses for “minutes per day”, of each activity was selectable in the form of five fixed possibilities: “30 minutes or less”, “31 to 60 minutes”, “61 to 90 minutes”, “91 to 120 minutes” and “more than 120 minutes”. Therefore, to calculate the estimated MET minutes per week of these data, responses were truncated and assumed to correspond to the following; “30 minutes or less” as 15 minutes, “31 to 60 minutes” as 45 minutes, “61 to 90 minutes” as 75 minutes, “91 to 120 minutes” as 105 minutes and “more than 120 minutes” as 120 minutes (Gerovasili et al., 2015). The same process was also performed to the GO fit members’ data to control for bias between the responses. Only adequate responses (a value in minutes provided rather than “don’t know”) were taken forward for analysis. In line with previous handling of data, the final PA values from truncated responses were excluded on a case by case basis for any PA values exceeding possible amounts. Previously, a value of 4600 MET.Mins.Wk^{-1}, was reported as the equivalent of running 6 miles per day at 10 minute-mile pace, 7 days per week (DeFina et al., 2019). High training volumes are also consistent with the weekly distance advised and performed by many master marathon runners, and hence provides rationale to include those training at very high levels (DeFina et al., 2019). Other research has shown PA levels that exceed 10,000 MET.Mins.Wk^{-1} in highly active individuals (Kyu et al., 2016). From this truncation process the maximum value possible was 12,852 MET.Mins.Wk^{-1}. Furthermore, the Eurobarometer data contained participants aged 15 years. These were removed to correspond with the GO fit members’ data aged 16 years and over.

4.2.7. Justification for the selection of specific survey questions

Personal characteristics were limited to those specific to basic identity and socio-economic factors so that the survey did not require too much time for completion. The IPAQ short form was chosen as it is widely used and is time-effective for participants. The IPAQ was scored as an accumulative total of PA over one week, measured in MET minutes per week (MET.Mins.Wk^{-1}).The fitness centre PA behaviour questions were selected for reasons of convenience and for the association with PA engagement at the fitness centre. These data were available from the database collected automatically by the check-in system at the fitness centre. Number of visits, visit duration, membership duration and group exercise class engagement were all recorded via this system. The question regarding motives was chosen as it allowed the selection of one answer from a list of possible motives and is a pre-existing question administered by the centre to its' members annually.

4.2.8. Data Handling and Analysis

This study used an observational, comparative, analysis, as well as non-parametric analysis of variance further to the Kolmogorov-Smirnov test reporting that the assumption of normal distribution was violated. Due to differences between the data set from the Eurobarometer, statistical analysis was not possible for all comparisons, and so graphical comparisons were made where required. The sample for the first analysis were respondents of the IPAQ short form, consisting of data from 4,063 participants which were cleaned and analysed for PA and exercise behaviour (Figure 9). For the observational analyses of fitness centre members, the valid responses were separated in to three areas of interest (Figure 9); these correspond to sections of the survey regarding; 1) Physical Activity and fitness centre engagement behaviour, 2) sitting time per day, and 3) motives. The sample characteristics are reported in tables 7, 12 and 14.

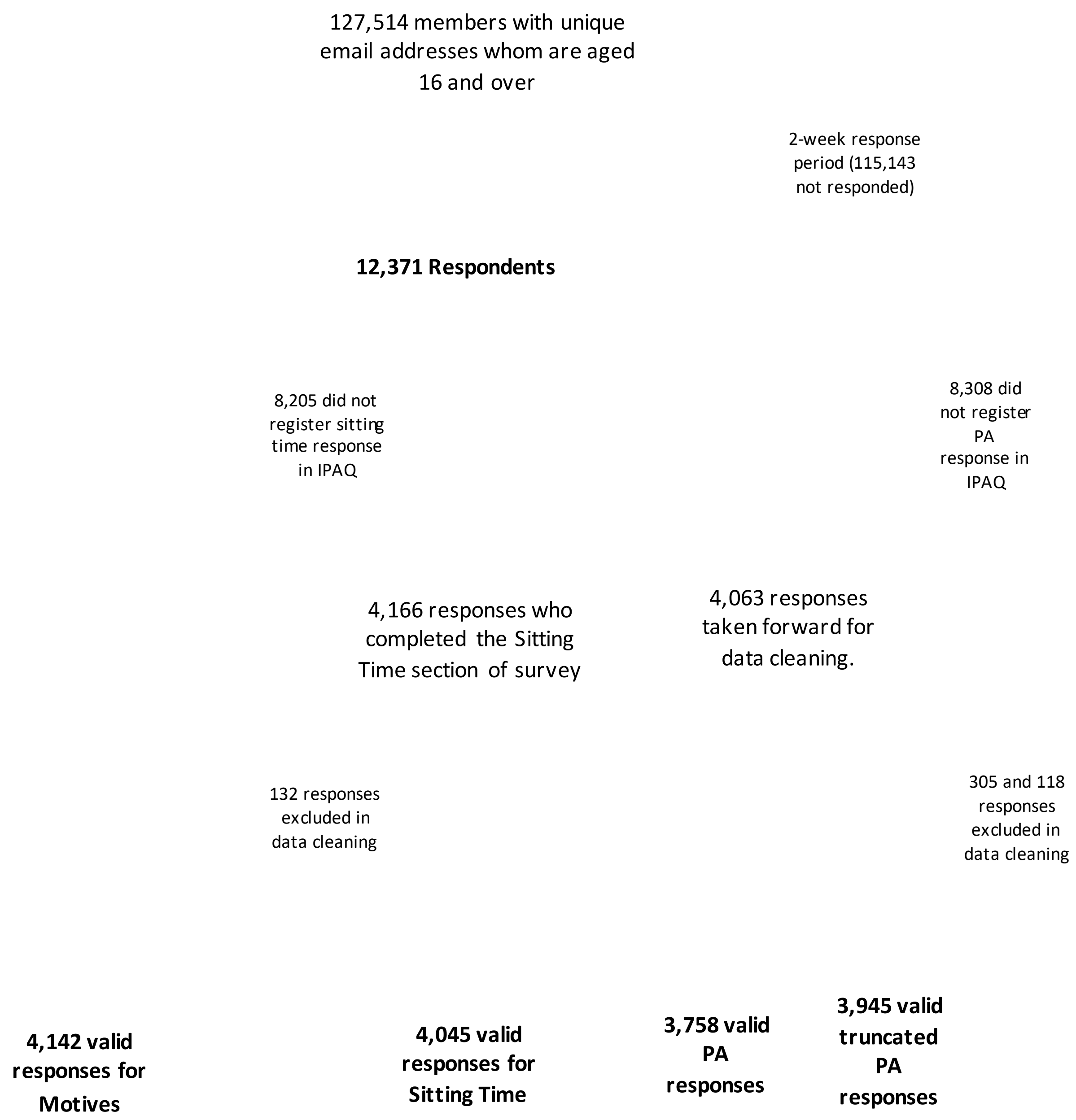

Figure 9: Flow Diagram of Survey Respondents for Studies in Chapters Four and Five

The final section of the survey investigated the motives of exercise and was completed by 4,142 members. These responses were collated and descriptive statistics were compared with data from the Eurobarometer for Spain and the rest of Europe. However, direct statistical analysis of these data was not available due to differences in the survey format and responses.

Data which were obtained from the Eurobarometer 472 survey 2018, were cleaned, and analyses included only participants aged 16 years or older, as this was the youngest age of the GO fit fitness centre members (EU28, $n = 18{,}586$; Spain, $n = 594$). For analysis between GO fit members' data and Eurobarometer data, overall PA ($MET.Mins.Wk^{-1}$) was calculated using the truncation process detailed in section 4.2.6.

Statistical Analysis

Statistical analysis was performed partially in IBM SPSS statistical package (IBM Corp. Released 2017. IBM SPSS Statistics for Macintosh, Version 25.0. Armonk, NY: IBM Corp.). Statistical analysis was also performed using Jamovi (The jamovi project (2020) Jamovi (Version 1.2) [Computer Software]. Retrieved from https://www.jamovi.org). Where possible, data from the present survey were compared with data from the Eurobarometer for Sport and Physical Activity Special Report 472.

For the analysis of regional PA behaviour in GO fit members, GO fit fitness centre locations were separated to; Northern ($n = 3$), Southern ($n = 6$) and Central ($n = 6$) and the moderate and vigorous PA performed in the previous seven days was then calculated for each region and compared with the rest of Spain.

Descriptive analysis was performed to present the mean and standard deviation for each variable. Where the Shapiro-Wilk test showed that the assumption of normality was violated, further statistical analyses were performed using non-parametric tests. In the case of multiple comparisons, the Kruskal-Wallis test (non-parametric ANOVA) was performed, and for significant interactions, Dwass-Steel-Critchlow-Fligner (DSCF) non-parametric procedure for significant pairwise comparisons was reported. All data are presented as means ± standard deviation; statistical significance was set at $p < 0.05$ (Cohen, 2013). For GO fit members, responses for fitness centre visits were analysed with motives in ANOVA to test for statistically significant differences in PA levels (fitness centre visits) between motives.

4.3. Results

12,371 responses were received and added into the GO fit database for cleaning and inspection. Data was excluded from further analysis if the participant did not provide answers to the respective sections of the survey. It should be noted that the numbers for each separation may represent the same people crossing over, for example a participant may have valid responses to the PA element and sitting time but not motives.

The data from the Eurobarometer was used as a comparison with the data from fitness centre members. This included the data from Spain (*n* = 1,002), and from the European Union 28 member states (*n* = 28,031; "EU28"). Not all members completed all questions within the survey and therefore comparisons and associations were made where possible between variables. The results were split into three separations, these were checked for representability of the fitness centre members' responses with regards to sex and age, showing no significant differences (Table 6).

Table 6: Sex and mean age of all valid responses

	SAMPLE (N=12,371)	IPAQ (N=3,758)	SITTING TIME (N=4,045)	MOTIVES (N=4,142)
SEX (F%:M%)	52:48	52:48	52:48	52:48
MEAN AGE (YEARS)	43.1	42.7	42.1	41.9

4.3.1. Physical Activity and Fitness Centre Engagement

After cleaning the GO fit data, the number of participants whose data were included for final descriptive analysis of PA and fitness centre engagement was 3,758. Seventeen members refused information regarding their employment (*n* = 3,741). There were 905 members who declined to provide information regarding their household monthly income (*n* = 2,853). These members were included in the analyses for which they had a complete set of responses, but were excluded from the analyses from which their data were missing. For example, an individual may have responded to the IPAQ and civil status but not responded to the question regarding level of income, therefore they would not be included for the analysis of PA levels and income.

The sample for PA and fitness centre engagement consisted of 52.3% female (n = 1966, age = 41.5 ± 12.2 years) and 47.7% male (n = 1792, age = 42.5 ± 12 years). From the members' responses, 95% were of Spanish origin; the distribution of the responses between centres is shown in Table 7. Most of the respondents came from the Madrid-based centres; Peñagrande and Vallehermoso (17.6% and 14.7%). Regarding employment status; 79.6% of members were in employment (68.3% employed, 11.3% self-employed / entrepreneur). Whilst for education, 70% of members reported a 'University or higher' level of education. Most of the members were married (43.5%) or single (27.9%). The most frequent levels of household monthly income were between €1500-€1999 and €2000-€2499 (14.7% and 14.1%, respectively).

Members from the Huelin centre reported the greatest amount of PA (4765.7 ± 3361 $MET.Mins.Wk^{-1}$), and significantly greater PA levels than members from Olivais (3269.7 ± 2718.1, $p < 0.05$) and Vallehermoso (3391.5 ± 2453.4, $p < 0.05$; Table 7). Members from Cordoba also reported a significantly greater PA level (4721.8 ± 3146.3 $MET.Mins.Wk^{-1}$) than members from Olivais, Vallehermoso and Campo Grande ($p < 0.05$). Students reported significantly greater PA levels than all categories of employment. Respondents with the lowest level of education also recorded the lowest amount of PA (3652.8 ± 2852.1 $MET.Mins.Wk^{-1}$). Members whose education was University or higher reported a significantly lower PA level than did members whose education level was secondary / baccalaureate (3710.7 ± 2696 and 4473.6 ± 3148.3 $MET.Mins.Wk^{-1}$, $p < 0.05$). Members whose civil status was "single", reported the greatest PA levels, significantly greater than married, divorced and widowed members ($p < 0.05$). Members in a relationship also reported significantly greater levels of PA (4116.9 ± 2831.2 $MET.Mins.Wk^{-1}$) than married and divorced members ($p < 0.05$). No significant difference in PA levels was reported for income.

Location (n = 3758)	***n***	**% of Total Respondents**	**Overall PA ($MET.Mins.Wk^{-1}$)**
Campo Grande	171	4.6 %	3459.9 ± 2780.5
Ciudad Real	128	3.4 %	4289.4 ± 3044.4

Córdoba[¥ʎ#]	171	4.6 %	4721.8 ± 3146.3
Huelin[¥#]	107	2.8 %	4765.7 ± 3361
Las Palmas[¥#]	314	8.4 %	4232.4 ± 3009.7
Maracena	66	1.8 %	4108.8 ± 3064.6
Montecarmelo	224	6 %	3687.2 ± 2778.2
Olivais	221	5.9 %	3269.7 ± 2718.1
Oviedo	133	3.5 %	3874.7 ± 2453.9
P San Miguel	196	5.2 %	3902.3 ± 2794.7
Peñagrande	662	17.6 %	3752.9 ± 2669.5
Plaza Elíptica	168	4.5 %	3733 ± 2631.8
Santander	139	3.7 %	3912.1 ± 2830.8
Segalerva	70	1.9 %	4222.1 ± 3107.8
Sevilla[¥#]	118	3.1 %	4457.1 ± 2930.7
Torrejón	125	3.3 %	4012 ± 2903.3
Valladolid	191	5.1 %	3741.7 ± 2761.1
Vallehermoso	554	14.7 %	3391.5 ± 2453.4
Employment Status (*n* = 3741)			
Employed Worker	2568	68.3 %	3734.3 ± 2729.7
Retired or Disabled	211	5.6 %	3769.6 ± 2931.4
Self-Employed	423	11.3 %	4017.7 ± 2880.3
Household Worker	68	1.8 %	3449.6 ± 2638.4
Unemployed	188	5 %	3787.1 ± 2882.3
Student[§]	283	7.5 %	4828.6 ± 3032.2
Education (*n* = 3751)			
University or Higher[†]	2633	70.1 %	3710.7 ± 2696
Vocational Training	537	14.3 %	3956.3 ± 2893.6
Secondary / Baccalaureate	510	13.6 %	4473.6 ± 3148.3
Primary or Less	71	1.9 %	3652.8 ± 2852.1
Civil Status			
Married[‡ǁ]	1634	43.5 %	3535.1 ± 2715.5
Divorced[‡ǁ]	183	4.9 %	3513.2 ± 2650.2
In Relationship	846	22.5 %	4116.9 ± 2831.2
Single	1050	27.9 %	4203.2 ± 2879.1
Widow[‡]	45	1.2 %	3183.3 ± 2825.7
Household Monthly Income (€) (*n* = 2853)			
500-999	514	13.7 %	3540 ± 2465.4
1000-1499	223	5.9 %	4347.5 ± 3175.7
1500-1999	552	14.7 %	4058.1 ± 2936
2000-2499	530	14.1 %	4002.8 ± 2825.2
2500-2999	472	12.6 %	3974.8 ± 2828.2
3000-4999	348	9.3 %	3836.6 ± 2749.3
>5000	214	5.7 %	3591.4 ± 2470.8

Table 7: Descriptive Statistics of Fitness Centre Members for Overall PA. Mean PA = 3847.47 ± 2803.77 MET.Mins.Wk^{-1}.

[¥]Significant difference with Olivais, [ʎ]Significant difference with Campo Grande, [#]Significant difference with Vallehermoso, [§]Significant difference with all employment types, [†]Significant difference with secondary / baccalaureate, [‡]Significant difference with "Single", [ǁ]Significant difference with "in relationship". Significance set at $p < 0.05$, data is presented as means ± standard deviation.

Table 8: Descriptive Statistics for PA and Fitness Centre Visiting Behaviour (Part II)

Visit Duration (Mins)	***N***	**% of Total Respondents**
Data Missing	513	13.7 %
1-60	416	11.1 %
61-90	1479	39.4 %
91-120	918	24.4 %
>121	432	11.5 %
Visits at Weekend		
Yes	1888	50.2 %
No	1357	36.1 %
Data Missing	513	13.7 %
Duration of Membership (Months)		
0-3	616	16.4 %
4-6	655	17.4 %
7-12	1266	33.7 %
13-24	316	8.4 %
>24	905	24.1 %
Books Group Exercise Classes		
Yes	1490	39.6 %
No	2268	60.4 %
Group Exercise Class Bookings per Month*		
1 to 3	530	35.6 %
4 to 6	343	23 %
≥7	617	41.4 %
Group Exercise Class Attendance* (Classes per Month)		
1 to 3	542	36.4 %
4 to 6	323	21.7 %
≥7	568	38.1 %
Book & Don't Attend	57	3.8 %

*n = 1490 (Yes respondents to booking group exercise classes)

The most frequently reported duration of membership was 7-12 months (33.7%; Table 8). Over half of the members who responded outlined that they visited the centre at weekends (50.2%). For participation in group exercise classes, 2268 members indicated they did not book group exercise classes (60.4%), and 1490 identified they did book group exercise classes (39.6%; Table 9). The most frequently reported category of group exercise classes attended per month was seven or more; (38.1%, n = 568), and 57 members reported booking group exercise classes but not attending (3.8%).

Table 9: IPAQ results and Fitness Centre Visiting Behaviour

	Sex	N	Mean	SD
Physical Activity (MET.Mins.Wk^{-1})	F	1966	3488.92	2718.01
	M	1792	4240.84***	2844.14
Visits per Month	F	1966	7.68	6.99
	M	1792	9.04***	7.84
Visits Duration (Mins)	F	1966	77.17	51.59
	M	1792	78.13	44.69

Mann-Whitney test for differences between sex for PA; *Significance $p < 0.05$; ***Significance $p < 0.001$

The mean PA level for fitness centre members was; 3847.47 ± 2803.77 MET.Mins.Wk^{-1}. The overall PA for males was significantly greater than females ($p < 0.001$; Table 9). Average visits per month was 8.33 ± 7.44 visits. Males visited the centre significantly more times per month than females (male = 9.04 ± 7.84 visits, female = 7.68 ± 6.99 visits, $p < 0.001$). The mean visit duration reported was 77.63 ± 48.42 minutes, and was not significantly different between males and females (male = 78.13 ± 44.69 minutes, female = 77.17 ± 51.59 minutes, $p > 0.05$; table 8).

For the truncated PA levels, Kruskal-Wallis non-parametric ANOVA indicated that GO fit members reported a significantly greater average PA level than did the EU28 and Spain from the Eurobarometer data (p < 0.001; Table 10). Spain did report greater PA levels than the average of the EU28, though this was not statistically significant. All groups reported levels greater than 600 MET.Mins.Wk^{-1}, which indicates that on average they were all moderately physically active, meeting the WHO recommended PA guidelines. In the case of GO fit members, PA levels indicated a highly physically active population according to guidelines (≥ 3000 MET.Mins.Wk^{-1}). Data presented in table 10 are mean ± standard deviation. The average age of GO fit members (42 years) was younger than that of Spain (50.6 ± 18.7 years) and EU28 (51.4 ± 18.2 years). The ratio of male and female respondents was similar amongst all populations.

Table 10: Truncated mean overall weekly physical activity from fitness centre members, European Union (EU28), and Spain.

	GO fit Members (N=3945)	**EU28 (N=18,586)**	**Spain (N=594)**
Overall PA (MET.Mins.Wk^{-1})	3099.78 ± 2204.69$^{¥ƛ}$	2355.61 ± 2331.19	2537.19 ± 2414.19

¥ Significant difference with EU28 p < 0.001
ƛ Significant difference with Spain p < 0.001

Truncated PA levels categorised to "High", "Moderate" and "Low" according to PA scoring guidelines indicates 43% of GOfit Members reporting "High", and 48% reporting "Moderate". The populations of EU and Spain reported 21% and 16% reporting "Low" PA levels, whilst 9% of GO fit Members reported "Low" PA levels (Figure 10).

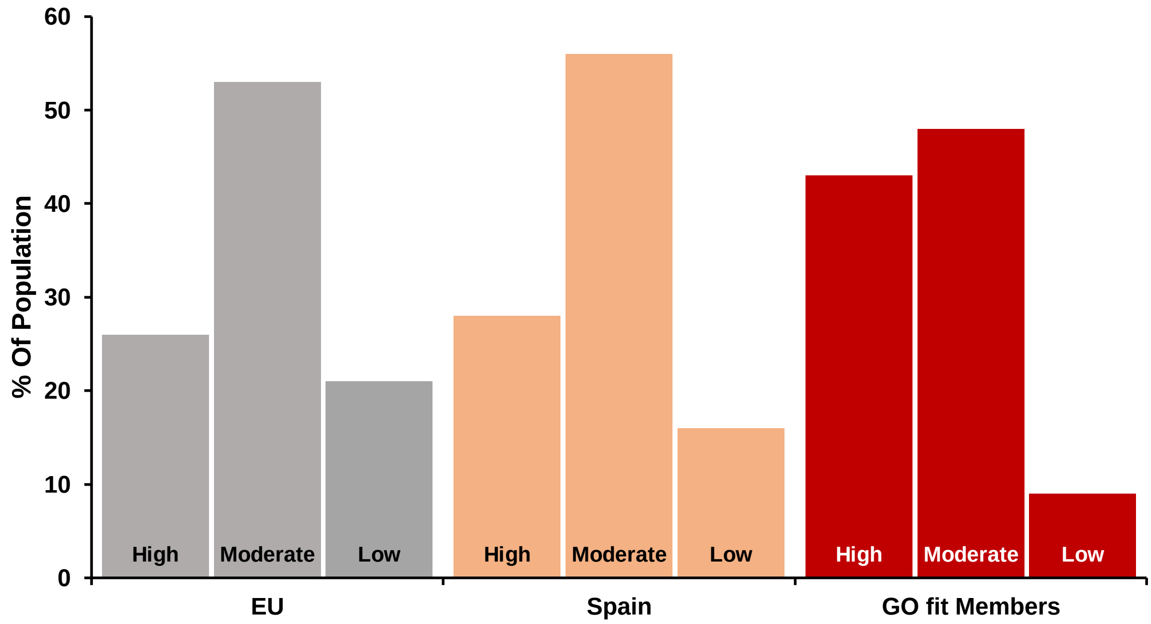

Figure 10: % of Populations Truncated PA Levels Categorised to High ($\geq$ 3000 MET.Mins.Wk^{-1}), Moderate (600-2999 MET.Mins.Wk^{-1}) and Low (> 600 MET.Mins.Wk^{-1}).

Figure 11 displays the reported number of days per week moderate PA was performed in the previous seven days, compared with EU28 and Spain. 46.5% of GO fit members reported performing between one and three days of moderate PA; the average of the EU28 was 29% and Spain, 23%. 45.5% of GO fit members reported doing no moderate PA per week, compared with 60% and 47% for Spain and EU, respectively.

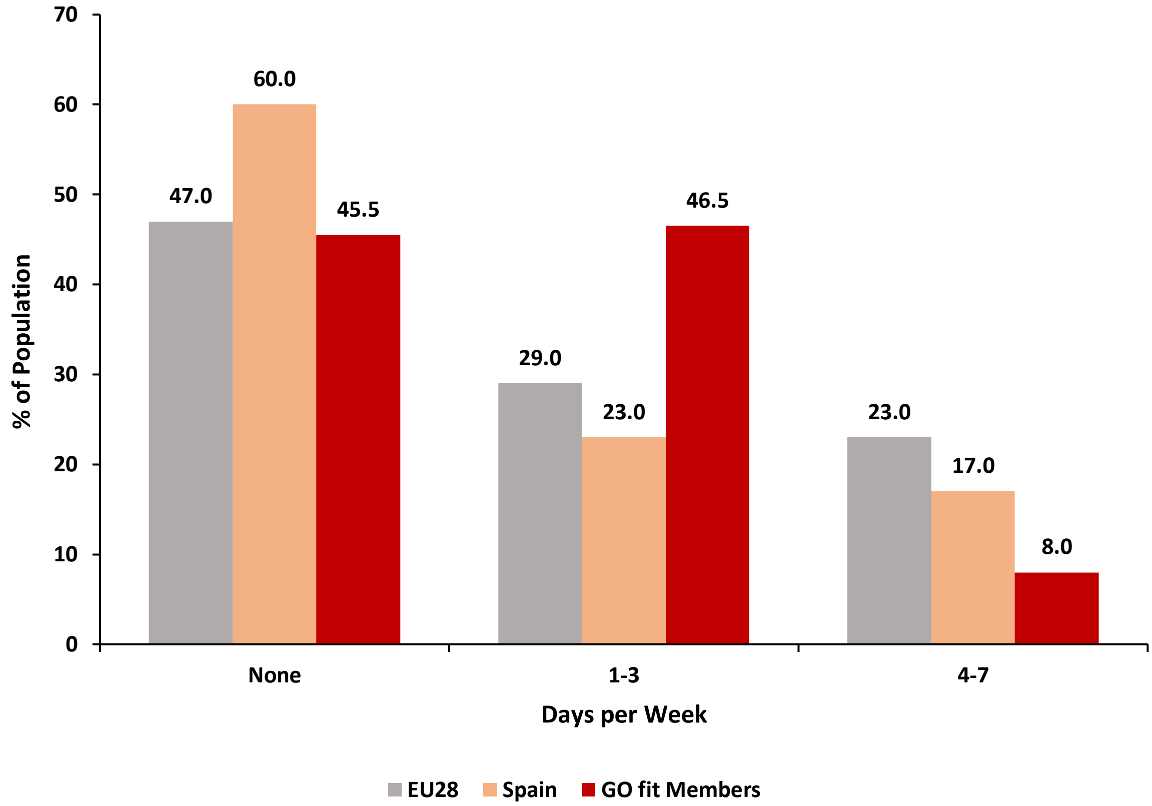

Figure 11: IPAQ data reporting number of days per week of moderate PA performed by EU28, Spain and GO fit members

Figure 12 displays the reported number of days per week that vigorous PA was performed in the previous seven days, by GO fit members, compared with EU28 and Spain. 33.8% of GO fit members reported doing no vigorous PA; the reported average for the EU28 was 47% and for Spain was 67%. 52% of GO fit members reported performing vigorous PA between one and three times in the previous seven days compared with 27% for the EU28 and 21% for Spain.

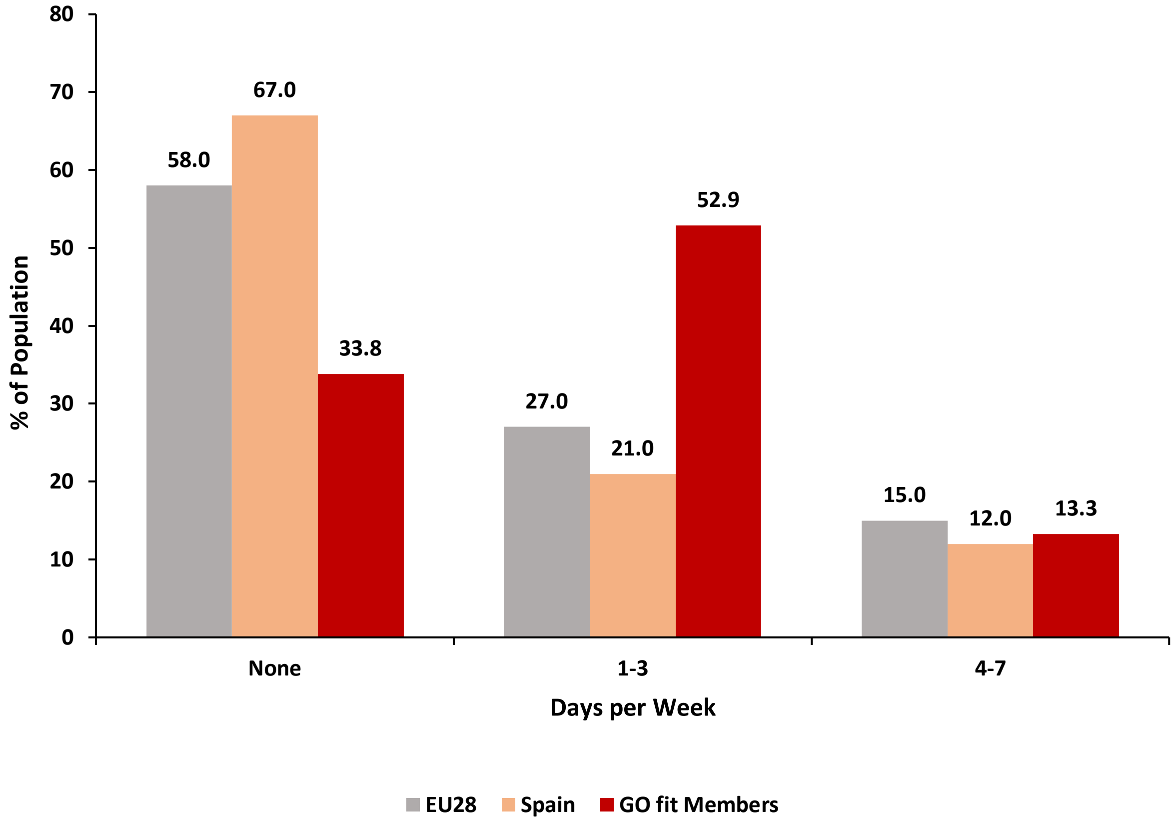

Figure 12: IPAQ data reporting number of days per week vigorous PA is performed by EU28, Spain and GO fit members

Figure 13 displays the frequency of performing moderate PA between geographical locations of fitness centres (Northern, Southern and Central) and the general population of Spain from the Eurobarometer data. No statistically significant relationships were found between location of fitness centres for the number of members that performed moderate PA per week ($p > 0.05$). Of GO fit fitness centre members, 45-46% performed no moderate PA (in the previous seven days), compared with 60% of the general population of Spain. 46-48% of GO fit members performed moderate PA 1-3 times per week. The largest difference between GO fit members and the Spanish population was observed for this frequency of performing moderate PA; Spain reported 23% of the surveyed population.

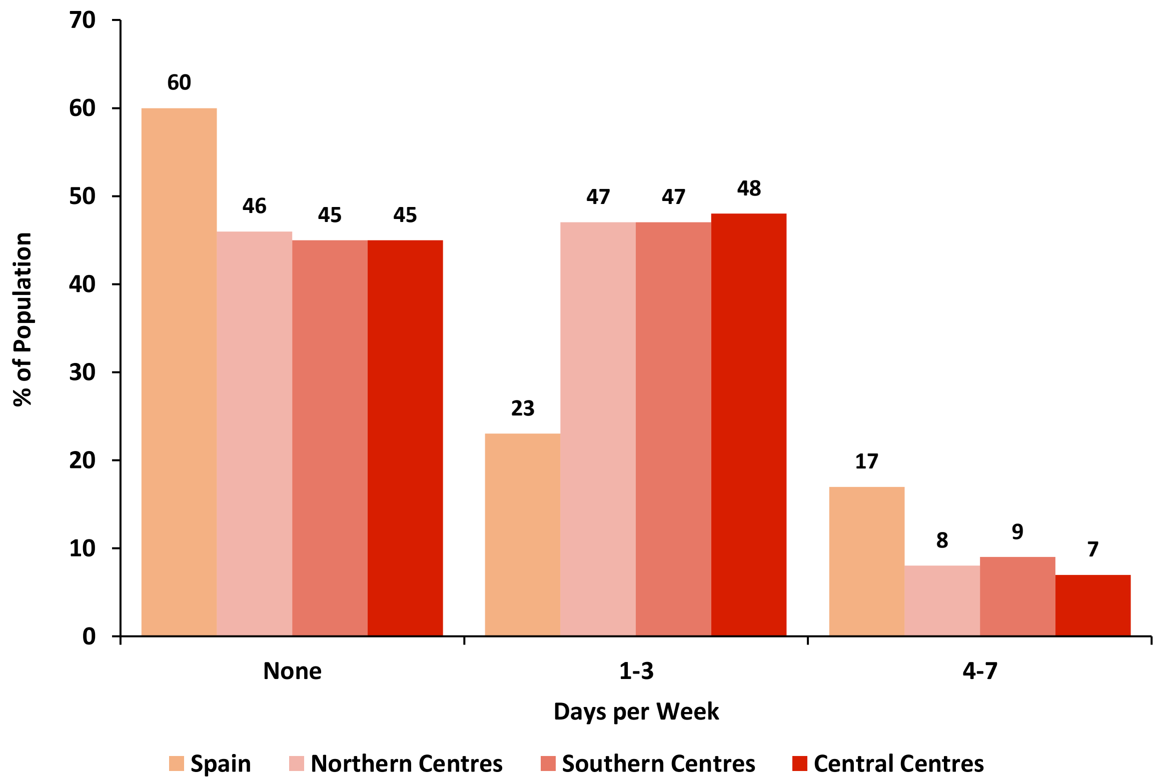

Figure 13: IPAQ data reporting, number of days per week moderate PA was performed by GO fit fitness centre members, by region and Spain.

For vigorous PA, no statistically significant relationships were found between vigorous PA being performed and regional location of GO fit fitness centres ($p > 0.05$). Members from centrally located centres reported 33.9% performing none, 53.7% performing 1-3 times per week and 12% reporting they perform vigorous PA 4-7 days per week, which was the same as reported in the Eurobarometer for the general population of Spain (figure 14).

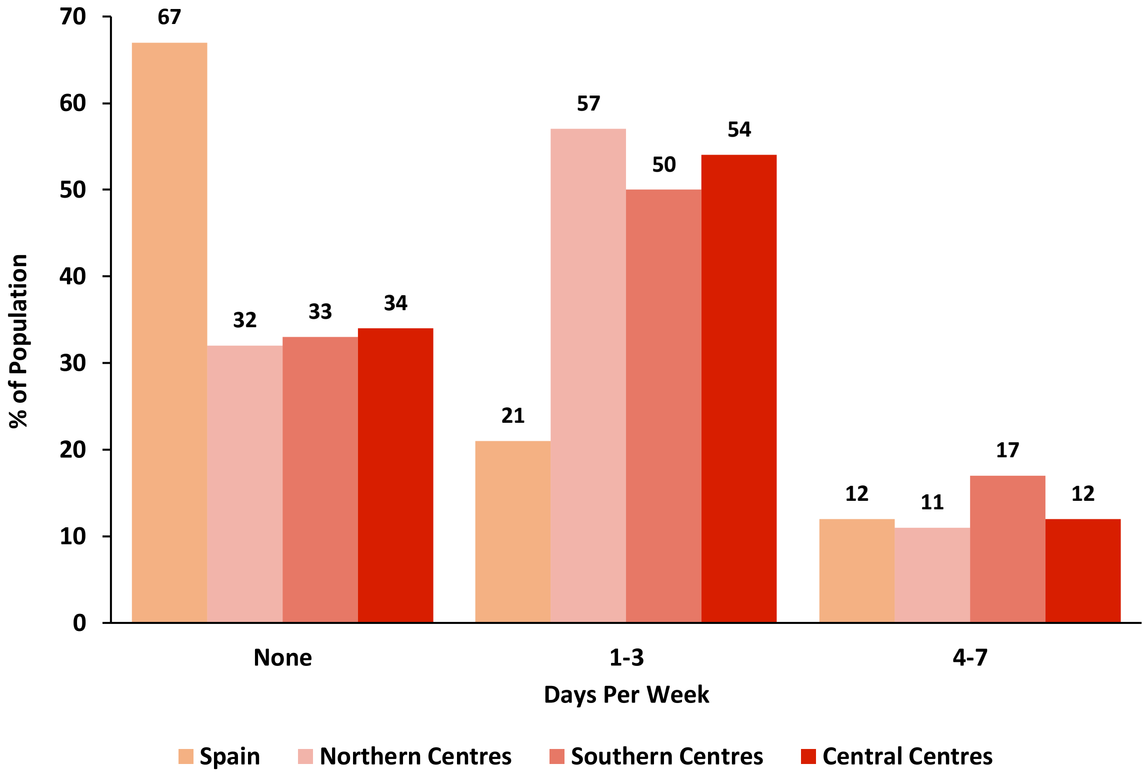

Figure 14: IPAQ data reporting, number of days per week vigorous PA was performed by GO fit fitness centre members, by region and Spain.

4.3.2. Sitting Time

From the 4,045 respondents who completed the sitting time questions of the survey, 2,104 were female (52%); age; 41.7 ± 12.2 years and 1941 were male (48%); age; 42.5 ± 12.1 years. Peñagrande location had the most respondents; 708 members (17.5%) and 583 from Vallehermoso (14.4%), both situated in Madrid, Spain (Table 11). For employment status, 2757 reported being employed (68.2%) and 451 self-employed (11.1%). For education level, 2796 members reported having a University education or higher (69.1%). Married members made up 1770 of the respondents, (43.8%). The most frequently reported household monthly income was between €1500-€1999, (n = 602, 19.7%; Table 11).

A Spearman rank order correlation test of association found a weak negative correlation between age and sitting time ($r_s = -0.1$, $p < 0.001$). No significant difference was reported for mean sitting time between female respondents; (357.8 ± 220 minutes per day), and male respondents, (362.4 ± 225.4 minutes per day). Table 11 shows the mean sitting time for members and the significant differences reported by a Kruskal-Wallis ANOVA for pairwise comparisons. Members from the Vallehermoso centre recorded a mean sitting time significantly greater than members from; Cordoba, Cuidad Real, Huelin, Las Palmas, Maracena, Santander and Valladolid ($p < 0.05$). Members from Peñagrande and Montecarmelo centres reported a significantly greater mean sitting time than members from Las Palmas and Santander ($p < 0.05$). Members from Campo Grande also reported a significantly greater sitting time than Santander members ($p < 0.05$). Members who were unemployed, retired, disabled or household workers had a sitting time which was significantly less than members who were employed, self-employed and students ($p < 0.05$). Members with a University education or higher reported significantly greater sitting times than all other education levels ($p < 0.05$). Members whose civil status was single reported a significantly greater sitting time than married and divorced members. Members in a relationship reported a greater sitting time than married members ($p < 0.05$). Members whose income was the lowest reported a significantly greater sitting time per day than members whose income was between €1000 and €2499 ($p < 0.05$).

Location	***N***	**% of Total**	**Mean Sitting Time (Mins)**

Campo Grande	180	4.4 %	371.9 ± 207.4
Ciudad Real[¥]	138	3.4 %	347.5 ± 210.4
Córdoba[¥]	181	4.5 %	311.9 ± 206.2
Huelin[¥]	116	2.9 %	332 ± 221.6
Las Palmas[¥ʎ#§]	342	8.5 %	317.5 ± 217.7
Maracena[¥]	77	1.9 %	300.3 ± 207.5
Montecarmelo	232	5.7 %	373.7 ± 204.7
Olivais	239	5.9 %	371.4 ± 242.4
Oviedo	143	3.5 %	383.3 ± 249.5
P San Miguel	218	5.4 %	366.2 ± 251.2
Peñagrande	708	17.5 %	364.2 ± 209.9
Plaza Elíptica	187	4.6 %	365 ± 226
Santander[¥ʎ#]	151	3.7 %	299.6 ± 231.7
Segalerva	79	2 %	361.5 ± 227.7
Sevilla	130	3.2 %	366.1 ± 222.1
Torrejón	132	3.3 %	342.8 ± 208.4
Valladolid[¥]	209	5.2 %	318.9 ± 227.8
Vallehermoso	583	14.4 %	420.3 ± 216.8
Employment Status (*n* = 4024)			
Employed Worker	2757	68.2 %	378 ± 222
Retired or Disabled[†]	237	5.9 %	244.5 ± 151.8
Self-Employed	451	11.1 %	354.5 ± 218.8
Household Worker[†]	78	1.9 %	275.3 ± 195.6
Unemployed[†]	197	4.9 %	293.6 ± 214.1
Student	304	7.5 %	366.8 ± 250.3
Education (*n* = 4036)			
University or Higher	2796	69.1 %	387.5 ± 216
Vocational Training[‡]	592	14.6 %	297.8 ± 224.4
Secondary/Baccalaureate[‡]	568	14 %	302.2 ± 225.5
Primary or Less[‡]	80	2 %	266.4 ± 222.1
Civil Status			
Married	1770	43.8 %	341 ± 214
Divorced	198	4.9 %	334.9 ± 191.9
In Relationship[ǁ]	902	22.3 %	374 ± 236.5
Single[ǁ¶]	1125	27.8 %	383.8 ± 226.4
Widow	50	1.2 %	342 ± 224
Household Monthly Income (€; *n* = 3,053)			
500-999[**††£]	540	17.7 %	387 ± 221.5
1000-1499	250	8.2 %	335.6 ± 233.9
1500-1999	602	19.7 %	334.2 ± 225.8
2000-2499	562	18.4 %	349.8 ± 212.2
2500-2999	508	16.6 %	363.1 ± 215.7
3000-4999[**††]	376	12.3 %	377.9 ± 203.2
>5000[††]	221	7.2 %	384.4 ± 204.7

Table 11: Demographic Statistics for Sitting Time per Day

[¥]Significant difference with Vallehermoso, [ʎ]Significant difference with Montecarmelo, [#]Significant difference with Peñagrande, [§]Significant difference with Campo Grande, [†]Significant difference with Students, self-employed and employed. [‡]Significant difference with University or Higher, [ǁ]Significant difference with Married, [¶]Significant difference with Divorced, [**]Significant difference with €1000-€1499, [††]Significant difference with €1500-€1999, [£]Significant difference with €2000-€2499. Significance set at $p < 0.05$, data is means ± standard deviation.

Sitting time responses for GO fit members from the IPAQ, were categorised into the corresponding categories from the Eurobarometer survey for analysis. The most frequently reported category of sitting time for the survey respondents was between 5h31min-8h30min (32.5%; Figure 15). A greater reported mean sitting time per day for the average of the European Union (29%) and for Spain (26%) was observed. For Spain, the most frequently reported sitting time per day was between 2h31min-5h30min (49%), the same category was the most frequent for the EU respondents from the Eurobarometer (40%).

Figure 15: A Comparison between GO fit Fitness Centre Members, EU28 and Spain of Sitting Time per Day (European Opinion Research Group, 2018).

4.3.3. Sitting time and Overall PA in GO fit Members

For a comparison between sitting time and overall PA, data from GO fit members who had responded to both items of the GO fit survey were analysed with non-parametric statistics ($n = 3743$). The most common category of sitting time was 5 Hours 31 Mins to 8 Hours 30 Mins ($n = 1217$, 32.5%; table 12). Members who spent the greatest amount of time sitting per day (8 Hours 31 Mins or more) achieved a mean PA of 3475 ± 2614 MET.Mins.Wk^{-1} (Table 12). Kruskal-Wallis ANOVA revealed statistically significant differences in PA levels between GO fit members who had a daily sitting time of 2 Hours 31 Mins to 5 Hours 30 Mins reporting greater PA than GO fit members whose daily sitting time was 5 Hours 31 Mins to 8 Hours 30 Mins ($p < 0.001$), and 8 Hours 31 Mins and longer ($p < 0.001$). A significant difference in PA was also observed between members whose sitting time was 2 Hours 30 Mins or less with members whose sitting time was 5 Hours 31 Mins to 8 Hours 30 Mins, and 8 Hours 31 Mins or more ($p < 0.01$).

Table 12: Descriptive statistics for sitting time and overall PA

Sitting Time Per Day	*N*	Overall PA (MET.Mins.Wk^{-1})
8 Hours 31 Mins or More	763	3475 ± 2614[¥ ƛ]
5 Hours 31 Mins to 8 Hours 30 Mins	1217	3531 ± 2631[¥ ƛ]
2 hours 31 Mins to 5 Hours 30 Mins	1117	4320 ± 2942
2 Hours 30 Mins or Less	646	4058 ± 2955

¥Significant difference with 2 Hours 31 Mins to 5 Hours 30 Mins $p < 0.001$
ƛ Significant difference with 2 Hours 30 or Less $p < 0.01$

4.3.4. Motives

4,142 members completed the motive section of the survey. Descriptive statistics are reported in table 13. Within this pool, 52% were female (age; 41.7 ± 12.4 years) and 48% were male (age; 42.4 ± 12.1 years). 69.5% (*n* = 2877) were University educated or higher, 78.4% (*n* = 3245) reported to be employed and 43.2% (*n* = 1788) reported they were Married. For household income, 1,019 members refused their data, (*n* = 3,123), 38.7% of members reported a household monthly income of between €1500 - €2499, (19.3% €1500- €1999; 19.4% €2000-€2499).

Table 13: Descriptive statistics for GO fit members that responded to motive survey section

Location	***N***	**% of Total**
Campo Grande	207	5.0 %
Ciudad Real	156	3.8 %
Córdoba	202	4.9 %
Huelin	110	2.7 %
Las Palmas	333	8.0 %
Maracena	85	2.1 %
Montecarmelo	224	5.4 %
Olivais	260	6.3 %
Oviedo	174	4.2 %
P San Miguel	244	5.9 %
Peñagrande	678	16.4 %
Plaza Elíptica	167	4.0 %
Santander	132	3.2 %
Segalerva	93	2.2 %
Sevilla	138	3.3 %
Torrejón	122	2.9 %
Valladolid	208	5.0 %
Vallehermoso	609	14.7 %
Employment Status		
Employed Worker	2769	66.9 %
Retired or Disabled	270	6.5 %
Self-Employed	476	11.5 %
Household Worker	75	1.8 %
Unemployed	210	5.1 %
Student	320	7.7 %
Missing	22	0.5 %
Education		
University or Higher	2877	69.5 %
Vocational Training	624	15.1 %
Secondary / Baccalaureate	582	14.1 %
Primary or Less	49	1.2 %
Missing	10	0.2 %
Civil Status		
Married	1788	43.2 %
Divorced	227	5.5 %
In Relationship	923	22.3 %
Single	1155	27.9 %
Widow	49	1.2 %
Household Monthly Income (€) (*n* = 3,123)		
500-999	538	17.2 %
1000-1499	256	8.2 %
1500-1999	604	19.3 %
2000-2499	606	19.4 %
2500-2999	517	16.6 %
3000-4999	396	12.7 %
>5000	206	6.6 %

Descriptive analysis revealed the most frequently reported motive for engaging in PA for fitness centre members was “Keep Fit and Feel Good” (48.4%, *n* = 2004; Figure 16). Other frequently reported motives were health and weight related. The motives are compared with the motives reported in the Eurobarometer, for the EU28 and then with Spain, whereby the most common motives were to improve fitness (EU28 = 47%, Spain = 38%), or to improve health (EU28 = 54%, Spain = 59%; Figure 17).

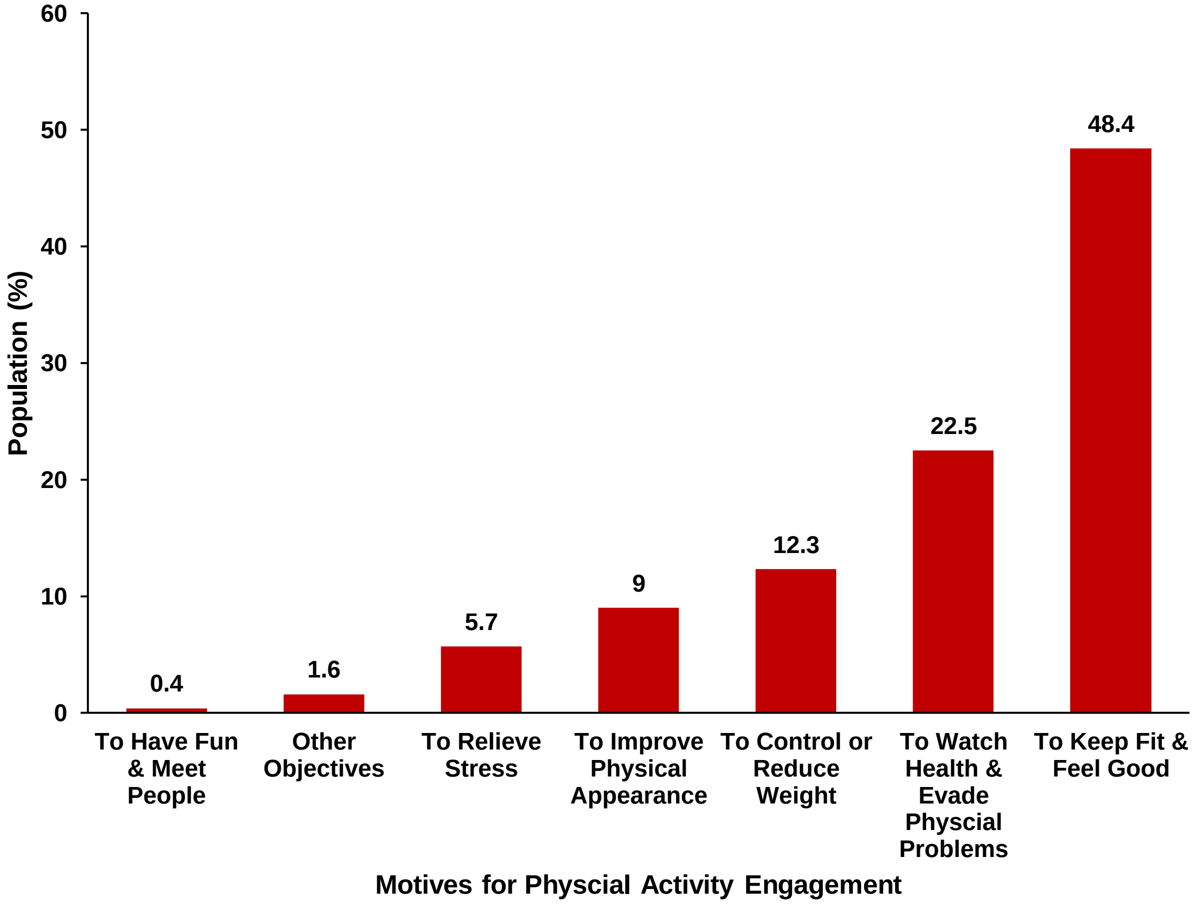

Figure 16: GO fit Fitness Centre Members' Motive for Engaging in PA (Pick One)

Figure 17: Motives for Engaging in Physical Activity (Multiple Answers Possible, (European Opinion Research Group, 2018))

4.4. Discussion

4.4.1. Main findings

The main findings of this study were: (a) fitness centre members performed a significantly greater amount of PA than the general populations of Spain and Europe; (b) fitness centre members average PA levels, classified them as "highly active" according to PA guidelines and IPAQ scoring criteria (WHO, 2019, Cheng, 2016); (c) male fitness centre members performed greater levels of PA than female members; (d) fitness centre members reported a greater prevalence of sitting (20%) for 8 hours 31 minutes or more, than Spain (7%) and EU28 (12%) and (e) "fun" as a motive for engaging in PA was less prevalent in fitness centre members than Spain and EU28.

Physical Activity

On average, the PA level achieved by GO fit fitness centre members was 3847.47 ± 2803.77 Met.Mins.Wk^{-1}. Following the IPAQ scoring criteria, fitness centre members would be classified within the "high" category regardless of how they achieved their PA (Papathanasiou et al., 2009, IPAQ Research Committee, 2005, Lee et al., 2011). Few studies have compared PA levels of fitness centre members with the general population, prior to Fernández et al. (2021). Although, a report of American fitness centre members also observed that fitness centre members have a high prevalence of performing "high" PA levels (Schroeder et al., 2017). These findings are supported by Gjestvang et al. (2020b) outlining that fitness centre members are more likely to meet PA recommendations than the general adult population. Fernández et al. (2021) noted in this population that as age increases the prevalence of low PA increases. This may be observed with the current study as the populations of Spain and EU28 had an older average age than the GO fit members population, potentially explaining some of the difference in PA levels. Male members achieved significantly greater PA levels than females, which is consistent with a previous review (Koeneman et al., 2011). The research undertaken by Mora et al. (2007), followed a large sample of healthy women over a 10 year period. They observed a linear trend in higher levels of activity and decreased CVD risk ($p<0.001$), with associations between a PA level of 200-599 kcal/week and an age and treatment-adjusted risk reduction of 27%. As such, if we consider that the difference in average overall PA levels between GO fit fitness centre members and Spain was around 500 Met.Mins.Wk^{-1}, that corresponds to approximately 530 Kcal, which would fit into this category of associated risk reduction. Of course, there are differences between the populations in terms of gender, although similar reductions in CVD risk have been observed in healthy male populations (Williams, 2010). The current study presents data from a single moment in time and hence, it is not possible to understand the long-term effects and association of increased PA levels and CVD risk reduction in this population.

The visiting behaviour of fitness centre members show that males visited the centre more each month than females. However, considering that this was only between an average of 7 and 9 visits per month, it is possible that some percentage of the overall PA levels was achieved outside of the centre. Hence, further research could investigate the effects of fitness centre membership has on overall PA levels and measure the PA achieved in each specific setting, similar to that of a domain-specific sitting time questionnaire (Wijndaele et al., 2014).

The Eurobarometer report suggests that the percentage of respondents from the population of EU28 and Spain indicate a lower prevalence of people engaging “fairly regularly” (1-3 times per week) in moderate PA than fitness centre members in the present study. The prevalence of “very regular” (4-7 times per week) moderate and vigorous PA levels, however, are similar amongst all populations. Considering these results, it may be suggested that “fairly regular” moderate and vigorous PA is the focus for many fitness centre members, rather than very frequent, moderate or vigorous PA or sport. The focus on “fairly regular” PA is supported by another study of fitness centre members which found that retention-bound members visited the centre around six times per month (Yi et al., 2021). An initiative of fairly regular PA may provide a suitable and more appealing initiative to non-members, as the negative expectations and fear-avoidance of high-frequency and vigorous exercise has been previously suggested to discourage the engagement of PA, and hence fitness centre membership uptake (Janssens et al., 2018).

Regarding vigorous activity, considerably more members of the public (EU28 and Spain) reported never performing vigorous activity, compared with fitness centre members. It may be suggested that to achieve greater intensity PA, specialised facilities and equipment are required, like those provided at fitness centres, along with strong internal motivation (Frazão et al., 2016, Herazo-Beltrán et al., 2017). Despite being unable to draw a connection between vigorous PA and motivation, in the present study, previous research by Sharifi et al. (2013) indicated that lack of motivation and stress are barriers to participation in vigorous PA (Tsitskari et al., 2017). Motivation is perhaps a point to consider when prescribing vigorous intensity exercise programmes, or the inclusion of vigorous PA in recommendations, as while this isn't frequently performed by fitness centre members, it is potentially performed even less by the general population. Hence, facilities and equipment as well as motivation and socioeconomic factors could potentially be a contributing factor, and warrant further investigation. For example, research by Humpel et al. (2002) has shown that these environmental factors have consistent associations with PA. Notably, it was reported by Sallis et al. (1992) that convenience of facilities, neighbourhood environment and home equipment were significant predictors of change in vigorous activity in men over 24 months. Environmental factors could help improve the prevalence of the general population not meeting current PA guidelines which were shown in this study to be 21%.

Environmental barriers to sport and exercise have been reported previously, such as lack of access to facilities and exercise equipment (Sternfeld et al., 1999). In a study of university students, the most frequently cited barriers to vigorous activity in an open-ended question format, were interpersonal (for example; motivation and responsibility) and intrapersonal (for example; attitude, behaviour, skill-level) barriers (Gyurcsik et al., 2004). The present study potentially provides more recent evidence that these associations still exist, as motives for GO fit members were different to the general population.

Despite the truncation process providing a way of comparing populations, this method may over or under-estimate actual PA levels by categorising continuous values, and therefore these values should be considered an estimation. As with any self-report data, the IPAQ is an estimation of PA levels. Hence, an additional analysis was performed using an upper and lower estimate for the truncation values. For example, a value of less than 30 minutes would equate to 0, a value between 31-60 minutes would equate to 31 minutes and so on, and for the upper estimate all values would equate to the top value of each category. The truncated values revealed a large impact on the values for Spain in the lower estimate. However, the pairwise comparisons with

GO fit members remained the same; scoring significantly greater PA than EU28 and Spain. For the lower estimate, a significant difference was reported between EU28 and Spain (Appendix 9.7).

The Eurobarometer IPAQ survey was conducted using face to face interviews, whereby the interviewer had the opportunity to ask questions about the intensity of activities so they could classify the individuals' PA accurately. In contrast, the IPAQ completed by GO fit fitness centre members was based online, and hence there were some invalid responses observed in the data cleaning process. Thus there is a possibility that answers may have differed if the IPAQ had been completed in face to face settings. Future investigations should be consistent for a more appropriate comparison between data sets, although fitness centre members were given the opportunity to ask questions via telephone or email should they have any. Both IPAQ formats from each of the surveys were otherwise consistent and conducted questions regarding "The previous seven days" opposed to "In a typical week" which is used in other surveys. Despite this consistency, using the "previous seven days" format may not reflect typical PA behaviour across a longer period of time. However, neither of the surveys were conducted in January or September, which are months usually associated with an increase in PA levels and fitness centre activity, suggesting a relatively accurate representation of typical responses for PA levels.

Sitting Time

Amongst fitness centre members the most populous category of reported sitting time per day was between 5 hours 31 mins and 8 hours 30 mins (32.5%), which was greater than the reported times for Spain and EU28. Despite the reported high PA levels of fitness centre members, their sitting time is also high, which is consistent with previous research and could interfere with the beneficial health outcomes produced by exercise (Schroeder et al., 2017, Cristi-Montero and Rodriguez, 2014). In comparison with other research from Bullock et al. (2017) sitting time appears to be similar in their population of International and Spanish individuals (31% spending between six and eight hours sitting per day). In contrast, it was reported in their study that those in the top category for sitting time were associated with a higher BMI and achieving less PA than all other categories (Bullock et al., 2017). It has been suggested that increased sedentary behaviour is a consequence of the increased use of technology to accomplish daily tasks, and a result of the modified behaviours whether it be at work, school, home, transportation or leisure (De Craemer et al., 2018, Rodulfo, 2019). However, PA even in small amounts, has been shown to attenuate the association between sedentary time and negative health outcomes (Cristi-Montero and Rodriguez, 2014). With an increased awareness of their own PA behaviour, it is possible that fitness centre members are aware of their sedentary behaviour, perhaps as an occupational or generational consequence, and hence rely on their fitness centre membership to attenuate the effects of sedentary behaviour. This supports the continued focus on engaging inactive and sedentary populations in increased PA behaviour.

There are some limitations to the sitting time questions. Firstly, data was collected by a single-item question of the IPAQ. The question requires an estimated answer "over the last 7 days" and is therefore supposed to be representative of that given week. It is also asking for the sitting time on a given week-day rather than an average of the overall week and thus might not be representative of sitting behaviour over the weekends. Single-item self-report questions for sitting time have been shown to significantly underestimate sitting time, compared with accelerometer-derived methods (Clemes et al., 2012). It may be suggested that the fitness centre members spend longer amounts of time sitting than was reported although the categorisation of sitting time might attenuate this difference. Single-item methods have also reported significantly less sitting time on weekdays than weekend days (Marshall et al., 2010). Domain-specific sitting time questionnaire has been used in other studies (Chau et al., 2011, Chu et al., 2018, Wijndaele et al., 2014), this method requires reporting sitting time for domains including work, travel, watching TV, using a computer and leisure time (Marshall et al., 2010). Whilst this is a more in-depth questionnaire and is useful in understanding specific sitting time, it is more time consuming and would mean including further questions to an already-long (15-20 minutes) survey, which may affect response-rate (Kazi et al., 2014). The IPAQ sitting time question has benefits in regard to ease of assessing a large population, and that it is collected alongside PA data within the same questionnaire. It also requires less time and no equipment, unlike other methods such as domain-specific questionnaires and accelerometry methods.

The response options to the sitting time question were re-categorised into four sections, to comply with the categories of sitting time reported by the Eurobarometer, which originally provided 10 single-choice answers to four sections in the report. The question which was used in the Eurobarometer had slightly different wording than the present study, with the main differences being that it did not require an answer based on the previous seven days but rather a “usual” day, and there was no reference to a week-day or weekend day. Differences between the answers may implicate the cross-examination of responses between the population of fitness centre members and the wider populations of Spain and Europe.

Motives

The present study compared the motives for exercise in public fitness centre members with those of the EU28 and Spain, from the Eurobarometer. Despite varying levels of PA amongst the populations, there is a similarity between their motives. Health and fitness related motives were reported most frequently for engaging in PA across all populations, however fitness centre members seemed to exercise for “fun” and the social element, less than EU28 and Spain. Motivation could potentially explain the difference in PA behaviour between these populations, as previous research has suggested that intrinsic motivation may not be the most important predictor of engagement in this domain and that one must place value on the exercise and recognise its importance on health and wellbeing (Edmunds et al., 2006, Mullan et al., 1997).

With regards to the survey itself, it may be more appropriate to provide fitness centre members with a larger range of motives to choose from. Selecting more similar options to those used in the Eurobarometer, would not only allow for more detailed responses, but also allow for a more robust comparison between the populations and across the literature. Furthermore, it might be more appropriate to use the motives described in the EMI-2 inventory, which is widely used in the literature. The motives reported by the fitness centre members contradict previous research from Tsitskari et al. (2017) suggesting that physical appearance ranks highly as a motive for those engaging in PA. However, the sample used by Tsitskari et al. (2017) was populated more by females (64%), compared with the current sample (52%), and younger participants (72.6% aged <39 years). The present study reported an average age in their early 40’s (42 ± 12.3 years), and more closely resembles the average age of a fitness centre member (Clavel San Emeterio et al., 2016). Thus, considering physical appearance ranked highly as a motive in their study, is not surprising for their sample due to the internal and societal pressures that exist within these groups (<40 years of age, and predominantly female) compared with the present study (Shin et al., 2017, Zervou et al., 2017). Understanding the common motives described in the present study, guides health and fitness organisations to produce more targeted strategies, which could improve PA behaviour (Alexandris and Tsiotsou, 2012, Goulimaris, 2016).

Socioeconomic Factors

Most GO fit members reported a University education or higher, and the PA and sitting time cohorts were in receipt of a household income below the national average of Spain. However, the most frequently reported income for GO fit members was similar to the average household income for Spain, which suggests that the sample is representative of the general population (INE, 2019). Income levels of fitness centre members may provide support for the notion that fitness centre membership has become more financially accessible and attainable in recent years. Further, the cost of GO fit membership varies amongst locations but is usually between €40-€50 per month (approximately £36 - £46), and a family membership (2 adults and 2 children) approximately €80 per month (approximately £73). The reported average price of fitness centre membership across Europe of €38.6, approximately £35 per month (Herman et al., 2019). Hence, the price of membership and the average household monthly income of members is around the average mark for what is typically expected, and are therefore representative.

The results regarding PA and income in GO fit members have some consistency with previous reports showing lower socioeconomic groups performing less PA than higher socioeconomic groups (Chinn et al., 1999). However, the findings could also be supported by more recent studies showing no association between socioeconomic status and regular fitness centre attendance (Gjestvang et al., 2020b). Socioeconomic factors such as education and occupation, did report the lowest level of education associated with the lowest PA levels, and self-employed members achieved greater PA than unemployed members. Furthermore, the fitness centres used in the present study are priced above other cheaper centres which are popular in Spain (GO fit membership costs approximately €45 / £40 per month, other options exist at €30 but with significantly lesser quality facilities), however they do have high value for money when the facilities are considered. Hence, given that the GO fit members reported having an income which is either lower than, or the same as the average income across Spain, it might be suggested that members consider PA important, and are therefore willing to spend on membership. The results from the motive section may provide support to the suggestion of fitness centre members valuing PA. Members whose motive was “keep fit & feel good”, essentially an intrinsically-derived motive, achieved significantly greater PA levels than members whose motive was “to control or reduce weight”, which is considered an extrinsic source of motivation. Further investigation is required to substantiate this, as well as consideration of biases within the sample of GO fit members within this study.

The population in the current survey only accounts for one brand of fitness centres and therefore those with different levels of income may choose centres which may be cheaper or more expensive, or more aligned with their affluence or expendable income. Despite the level of income in fitness centre members being quite evenly spread, income as a socioeconomic status factor has previously been correlated with an elevated PA level in a review by Kono et al. (2018). However, it should be noted that the study containing information on income within their review was published 25 years ago and could be regarded as outdated, given the new, more-accessible exercising options such as cheaper fitness centres, access to virtual personal trainers, and the progression of park facilities. Re-analysis including more recent studies is necessary to asses this relationship in today’s society (McCarville and Smale, 1993, Lowe and ÓLaighin, 2012). Furthermore, participation in team-sports has been shown to increase as socioeconomic status decreases, and with some fitness centres, like GO fit, offering team-sport-based exercise options, this also warrants further investigation.

In all samples of members, a University education was reported in at least 69%. This suggests that fitness centres have a greater proportion of members with a tertiary-level of education than the average across Europe and Spain. The average across the EU for adults aged 30-34 years is 40.7% and Spain; 42.4% (Eurostat, 2018). Further support for the association between education and PA behaviour is reported by a previous study correlating a greater education level with greater levels of PA (Bauman et al., 2012). However, a study from Mielgo-Ayuso et al. (2016) investigating the PA patterns of the Spanish population, found that a lower education level was correlated with higher levels of PA and that females with a University level education were found to have the lowest levels of PA. The contradictory results reported by Mielgo-Ayuso et al. (2016) were thought to be explained by the economic downturn in 2008, which affected behaviour during the data collection period of their study. Thus, the data reported in the present study may be seen as an update and more useful for comparison with other recent data. Given the conflicting evidence regarding socioeconomic status and PA in the literature, these variables within fitness centre members should be further investigated for potential predictors of greater PA levels. It is also suggested that this sample of GO fit members may suffer from selection-bias toward a high socioeconomic group, as well as response bias with those individuals being the more active than non-responders which could affect the results of this study.

Sex

Males reported significantly greater PA than females, although the PA level of females is still classified as highly active according to the IPAQ guidelines. There were also more female respondents than male. Hence, considering barriers to PA, it could be suggested that barriers for females which have been previously reported such as socio-cultural factors (Abbasi, 2014), are less prevalent in the population of GO fit members (Kono et al., 2018). Although, the two studies in a review by Kono et al. (2018) which reported a significant correlation with PA and sex, (Rhodes et al., 1999, Trost et al., 2002) may be regarded as outdated, considering the ever-changing landscape of exercise behaviour, particularly for women, and the development of female-only exercise areas and more-appealing exercise options (Bauman et al., 2012). Three more recent studies of sex reported by Kono et al. (2018) were either non-significant or inconclusive (Kaewthummanukul and Brown, 2006, Van Stralen et al., 2009). It is possible that the barriers to exercise experienced by females, have changed over the last twenty years, and thus participation in PA amongst females has increased (Roper and Polasek, 2014).

4.5. Limitations

Some limitations of this study should be considered. Firstly, these data are from various sub-surveys which means respondents cannot be matched to all questions and hence this has impacted which inferences can be made for analysis. Secondly, this study examines cross-sectional data and therefore represents the population at a specific time, and hence prohibits causal inferences. The study focuses on one brand of fitness centres and might not be appropriate to say that they are representative of all fitness centre members due to price and availability. As previously stated, it may also be the case that fitness centre members are already more active individuals, and hence is the reason they purchase fitness centre membership. This study does also rely on self-report data for PA in the form of the IPAQ, which has previously been shown to overestimate PA levels and underestimate sitting time (Lee et al., 2011, Clemes et al., 2012). However, considering the present study, the use of the IPAQ was necessary to draw comparisons with data from wider populations, and has been recommended for studies like this (Bullock et al., 2017). Furthermore, direct measures of PA were also used alongside self-report measures and therefore it is accepted that an accurate reflection of PA levels were recorded.

Whilst fitness centre visits were considered an indication of PA, it might not be accurate to suggest that each visit did consist of PA. Visits may have consisted of solely stretching, and considering that fitness centres provide such a wide range of activities for example, spa and wellness activities (hydrotherapy or Jacuzzi) members may be visiting to use these. Hence, a more detailed investigation into the specific behaviour within the centre in the future, would provide more insight on this.

Cross-examination of surveys can encounter problems when making definitive conclusions from comparisons, given the differences in the wordings of the question and the responses available for each question differing. In the case of motives from the Eurobarometer, the survey allowed multiple answers, whereas the current survey required a single answer. Motives were also grouped into the seven motives recognised in the current projects' survey for comparability. It is worth noting that whilst the Eurobarometer is administered in the general population, figures from European countries have outlined that up to 20% of the population could be fitness centre members (approximately 13% of the Spanish population aged >15 years have a fitness centre membership), and this could produce an increased prevalence of PA in these populations (Herman et al., 2019).

It is acknowledged that the PA guidelines mentioned throughout correspond to adults aged between 18 and 64 years, and the included populations in this study exceeded this age range (>16 years). However, as the primary focus of the study was not to assess how many of each population are meeting these guidelines, but to compare the characteristics of these populations with each other, it is felt that the inclusion is warranted. Furthermore, the PA guidelines for the "adult" population are the greatest out of all the guideline categories, and yet the population of fitness centre members were still shown to be more active than other populations.

A final limitation of the present study is the effects of non-response and volunteer (selection) bias in the population of GO fit members as well as the Eurobarometer participants. Responders to surveys regarding PA behaviour are typically more active than non-responders which can affect how representative the sample is of the target population. There is a selection bias toward socioeconomic status of the GO fit members, which is potentially higher than the general population, and may not represent members of other fitness centres. In the case of the IPAQ there is the possibility of misclassification bias as the individuals were categorised from this as low, moderate or highly active based on their self-report answers to the survey.

4.6. Conclusion

This study showed that fitness centre members are highly active, and more active than the wider population of Spain and Europe. The current survey is only the second to produce a large sample of fitness centre members in Spain, and report descriptive information comparable to that of the wider population of Spain and the EU. This study appears to be the first at analysing fitness centre PA behaviour, motives and sitting time within members. The majority of GO fit members' PA was achieved by engaging in moderate and vigorous PA, and reported a lower prevalence of not meeting current PA guidelines. Males reported significantly greater average overall PA levels than females (males = 4240.84, females = 3488 MET.Mins.Wk^{-1}). Other than average monthly income, socioeconomic factors seem to be associated with PA behaviour, such as having a high education level and employment. Motives for exercise showed a lower proportion of fitness centre members reported "fun" as a motive, compared with the general population. Considering the PA levels of fitness centre members, it may be appropriate to consider the amount of PA is achieved away from the fitness centre, but this is an important setting in achieving high levels of PA.

Future research should investigate the quantity of exercise achieved within and outside of the centre, as well as the specific activity performed in fitness centres and whether this has significant benefits to health outcomes. Motivation or predictors and barriers of PA in fitness centres should be studied to aide understanding of who is performing PA and how to engage populations in long-term PA behaviours.

Chapter 5.

Predictors of PA Behaviour in Public Fitness Centre Members

5.1. Introduction

In chapter four, GO fit members were more active than the general population, thus more likely to have lower CVD risk (Mora et al., 2007). Previous reports have suggested that despite fitness centre membership not necessarily equating to habitual PA, members demonstrate greater health awareness than non-members (Ready et al., 2005). There is very little research exploring the predictors of PA engagement in this population, or on a large scale (Clavel San Emeterio et al., 2020, Clavel San Emeterio et al., 2019). Many factors can affect a persons' PA behaviour, both personal and environmental, and the wider determinants of health (Nobles et al., 2019), although this is not well defined in public fitness centre members.

Reasons for exercise engagement in fitness centres are likely multi-factorial, consisting of socioeconomic factors as well as motivational factors (O'Donoghue et al., 2018). Despite membership costing a set amount at specific fitness centres, socioeconomic factors may still influence PA behaviour, such as education level, occupation, sex and age, which can all influence leisure time availability (Cerin and Leslie, 2008, Droomers et al., 2001). Fundamental movement skills and physical fitness in adolescence have been shown to predict PA behaviour, and more strongly predict high intensity PA (Jaakkola et al., 2016). Another study investigating American adults, reported that enjoyment better predicted PA behaviour than self-efficacy, suggesting this should be the focus of PA interventions at the initiation (Lewis et al., 2016). However, following a review of reviews by Choi et al. (2017) it was reported that the predictors for PA in the general population are both personal and environmental such as age, intention to exercise, self-efficacy and accessibility and neighbourhood aesthetics. Although, they propose that more primary studies should be conducted to understand the causes of PA behaviour. These results are further supported by Humpel et al. (2002) who reported exercise environmental elements such as aesthetic attributes, opportunities and accessibility best predict PA behaviour.

However, the literature in fitness centre members is more scarce. Kaufman et al. (2019) found that members of New York City fitness centres reported greater PA levels than those without membership, supporting the previous study. Further, it was reported that a college degree was more prevalent in members of fitness centres and members lived in neighbourhoods which were further from the federal poverty line. Finally, those who live nearer to facilities, were younger and had a higher education level, were more likely to report membership. Income and duration of membership were shown to be significantly associated although direct measures of the fitness centre usage is absent in this association (Kaphingst et al., 2007).

Socioeconomic variation in PA has been well researched, and is a key determinant of participation in PA. Income often dictates the location of ones' home, and hence this can affect access to PA facilities and PA levels (Kavanagh et al., 2005). Income also affects the availability of overall leisure time, for example, longer commutes to work, and the safety of neighbourhoods (Schipperijn et al., 2017). A study investigating education level and other predictors of leisure time PA, outlined a significant difference in PA between socioeconomic groups (Droomers et al., 2001). In a seven-year study in the Netherlands, people classified as having lower socioeconomic status, were less likely to perform PA. Research from the UK has found similar outcomes in the general population (Chinn et al., 1999). Further, gender and age have previously shown to predict exercise behaviour (Stephens and Caspersen, 1994). Regular male exercisers are more likely to perform high-dosage exercise and females more moderate and low-dosage (Lox et al., 1999). It is proposed that younger individuals perform greater PA due to more available leisure-time PA, and decreases as familial and occupational responsibilities increase throughout the life-course.

Fitness centres provide facilities enabling a broad range of exercise options such as aerobic exercise machines, free weight facilities and group exercise classes. The increase in popularity of public fitness centres has highlighted their importance in the promotion of a healthy and active lifestyle (Clavel San Emeterio et al., 2019). Further, predicting PA behaviour of fitness centre members is useful for public health initiatives, as it allows the identification of those least likely to engage in higher levels of PA, as well as those most likely to stop their exercising. These groups can then be targeted for intervention to improve their PA behaviour to sustained long-term adherers to PA.

In chapter 2, self-determination theory provides three psychological needs; autonomy, competence and relatedness. With regards to motivation for PA, autonomy may refer to exercising because it is part of one’s identity or because it is interesting and enjoyable, whereas relatedness may refer to achieving an external reward, such as a weight loss goal (Taylor et al., 2010). By identifying the motives for those who are the most physically active members, individualised programmes and strategies can be designed, not only to maintain engagement but also to potentially engage less active individuals. Lox et al. (1999) reported that internally-attributed motives predicted higher dosage exercisers, compared with lower dosage exercisers. Intrinsic motivations derived from the autonomy needs are likely to produce a more long-term engagement in PA. Understanding the motivation of fitness centre members, particularly those which are most active, can help the design of PA interventions to increase PA behaviour in less active members, like those identified in the previous chapter.

It is expected that different motives for exercise will correspond to different levels of PA for fitness centre members. Since the increase in popularity of group exercise classes, research has found that once members identify with a group, session attendance and PA levels increase (Stevens et al., 2018). Group exercise classes within fitness centres do rely on some form of supervision and leadership, but are more accessible than 1-to-1 supervised training programmes, which do not represent a typical fitness centre experience. Whilst group exercise classes have been reported to improve overall health, we do not know if attendance is a predictor of higher PA levels (Komatsu et al., 2017).

Thus, it is anticipated that by understanding and applying knowledge of predictors to engagement in PA behaviours, we can understand which individuals are likely to become long-term adherers to PA which could improve CVD health outcomes.

5.1.1. Aims

The present study aimed to investigate the predictors of PA behaviour, including socioeconomic, demographic, motivation and fitness centre engagement predictors.

5.2. Methods

5.2.1. Participants

The participants of this study were GO fit members whose data were retrieved from the GO fit survey outlined in chapter 4 section 2.1. These participants were selected from the pool of respondents to the survey and only excluded if a response to the present question required for analysis was absent.

5.2.2. Study Design

Methods follow those described in chapter 4 whereby the GO fit survey was administered and answers obtained for retrospective analysis. Data were subject to analysis to investigate the predictors of PA. Four separate analyses were undertaken (figure 18); 1) to outline predictors of PA (MET.Mins.Wk^{-1}) and included independent variables outlined in figure 19, which did not include motives, 2) predictors of fitness centre visits (visits per month), 3) predictors of membership duration (months) and, 4) predictors of group exercise class attendance (number of classes per month).

There was no cross-over between the participants who answered the IPAQ and those who answered the motive question and hence the data from those members were subject to analysis regarding fitness centre visits, membership duration and group exercise class attendance, which were used as an indication of engagement in PA (Figure 18, 19).

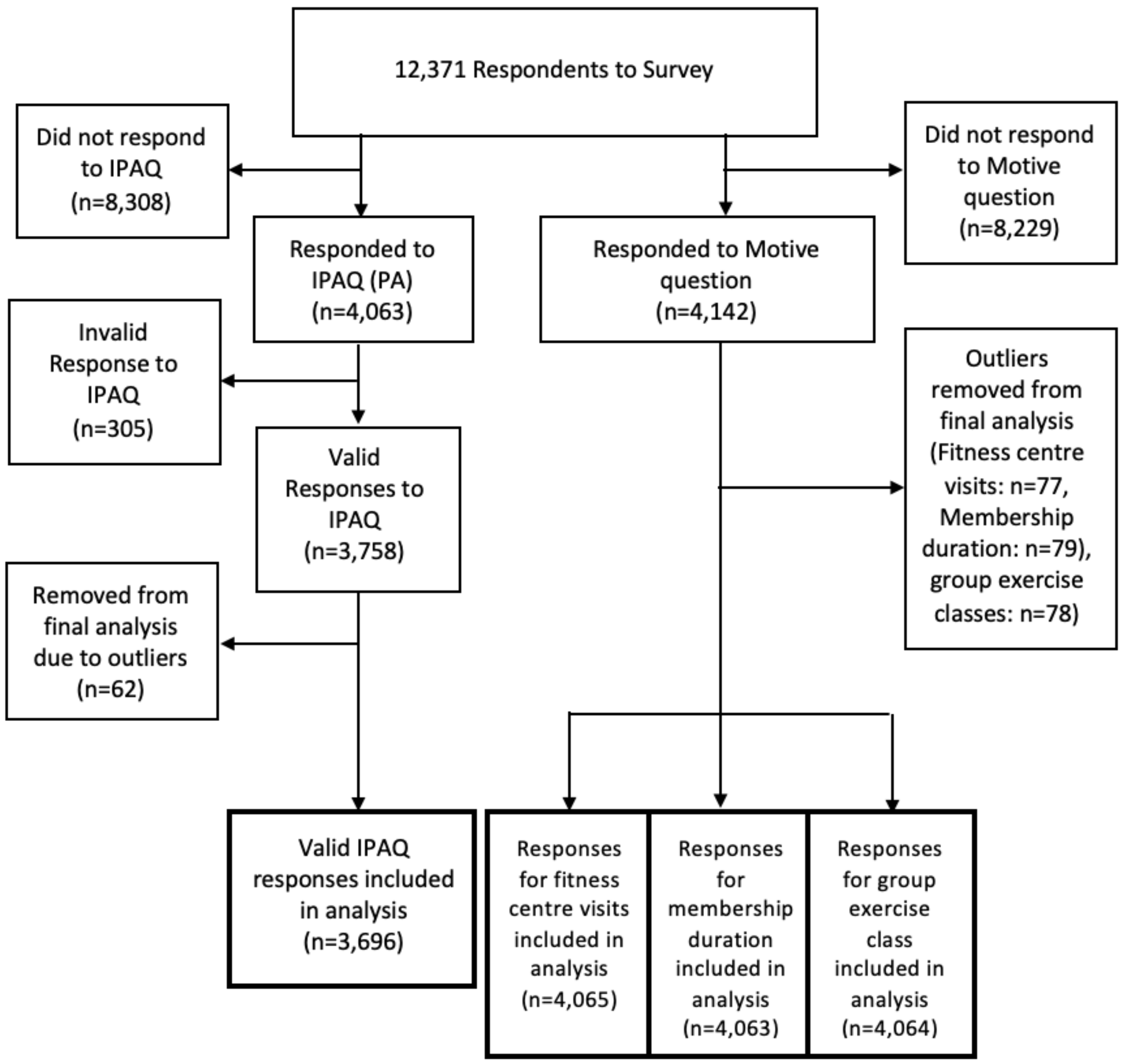

Figure 18: Flow chart for responses included for final analyses

5.2.3. Data Handling and Analysis

This study used a univariate analysis to outline significant predictors of PA or other indicators of engagement in exercise such as fitness centre attendance, membership duration and group exercise classes. A multivariate regression analysis was performed to build a model of the most significant predictors. Outliers were excluded from the analysis using Mahalanobis distance, or from the list-wise cases elimination during regression analysis which is described in further detail below. Statistical analysis was undertaken using IBM SPSS statistical package (IBM Corp. Released 2017. IBM SPSS Statistics for Macintosh, Version 25.0. Armonk, NY: IBM Corp.).

First, PA and participant variables were analysed separately using univariate analysis to outline statistically significant variables that were predictive of PA ($p<0.05$). Statistically significant variables from the univariate analysis were used in the modeling for a multiple linear regression analysis to predict participant's PA. A stepwise elimination analysis was performed using only the significant predictors in the final model. Cases were excluded list-wise so that if a participant had any missing data for any of the variables, that participant would be removed. Preliminary analyses were performed to test for violation of assumptions. The assumption of normality of the variables was violated, although due to the size of the sample and the analyses undertaken this was dismissed. The assumption of heteroscedasticity showed small skewedness in the residual errors, checking for the normality within the standardised residuals, evidenced by the P-P plot of standardised predicted values and standardised residuals. Although, this was not substantial and the model was accepted. The assumption of multicollinearity was met. Regression analysis outlined a violation for the assumption of outliers evidenced by Mahalanobis distance exceeding an expected maximum. Due to the sensitivity of the regression analysis to outliers, outliers were removed using the cumulative distribution function for chi-square which produced the probability of a value from the chi-square distribution. This allowed final analyses on the sample and the regression analysis performed again with all assumptions met or acknowledged (n=3696).

The same procedure was performed to model the second, third and fourth multiple regressions predicting the number of fitness centre visits (visits per month), membership duration and group exercise class attendance. Prior to the regression analyses for fitness centre visits, a non-parametric (Kruskal-Wallis) ANOVA was performed to investigate significant differences between motives and number of fitness centre visits per month. As with the first regression analysis, preliminary tests were performed for assumption of violations. Homoscedasticity and multicollinearity was not violated, although Mahalanobis distance was larger than the expected maximum and therefore suggested outliers in the data set. These outliers were also removed using the cumulative distribution function for chi-Square allowing final analyses on the sample (fitness centre visits, n=4065; membership duration, n=4063; group exercise class attendance, n=4064). Cases were excluded pairwise, hence the final sample included in the models was sometimes less, due to absence of answers for some independent variables. The comparisons between variables are displayed in figure 19.

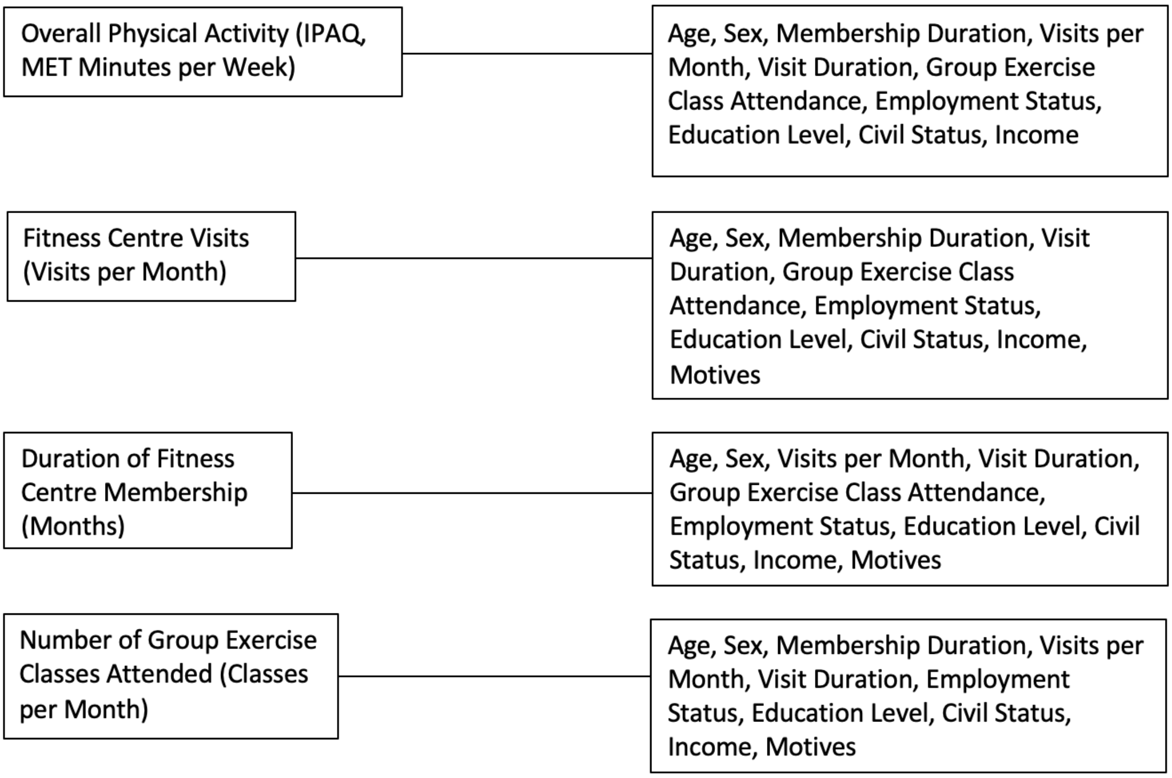

Figure 19: Possible associations from repsonses to the survey of fitness centre members in the study population

5.3. Results

5.3.1. Independent Predictors of PA

Univariate linear regression analyses for PA are presented in table 14. Older age was significantly negatively associated with PA ($b=-35.182$, $p<0.001$). Sex (male) was significantly associated with greater PA ($b=853.262$, $p<0.001$), as was civil status (married) ($b=83.149$, $p<0.001$). A greater number of fitness centre visits, average visit duration and the number of group exercise classes attended per month, were positively associated with increases in PA ($b=70.184$; $b=6.43$; $b=66.813$ $p<0.001$). Other significant independent predictors of increased PA were; 1) being a student, 2) having a secondary level of education, 3) being married, divorced or a widow, and 4) having a monthly household income of between €500 and €999 or €1000 and €1499.

Table 14: Univariate regression analysis of PA in the study population

Variables	*b*	95% CI
Age	−35.182	−42.510 - −27.855†
Sex (Male)	853.694	679.012 - 1028.376†
Membership Duration (Months)	4.055	−0.184 - 8.293
Visits per Month	70.184	56.799 - 83.568†
Visit Duration (Mins)	6.430	4.597 - 8.263†
Group Exercise Class Attendance (Classes per month)	66.813	50.333 - 83.293†
Houseworker	−322.070	−1087.533 - 443.392
Self-Employed	245.964	−219.522 - 711.450
Student	1056.934	555.269 - 1558.599†
Retired or Disabled	−2.143	−538.560 - 534.274
Employed	−37.385	−434.370 - 359.601
University or Higher	−237.085	−494.957 - 20.777
Secondary / baccalaureate	525.848	188.375 - 863.321‡
Primary or Less	−295.026	−985.922 - 395.869
Married	−581.777	−813.175 - −350.379†
Divorced	−603.637	−1049.029 - −158.245‡
Single	86.367	−166.031 - 338.764
Widow	−933.530	−1769.311 - −97.748¥
€500-€999	−281.787	−563.353 - −0.222¥
€1000-€1499	525.684	131.027 - 920.341‡
€2000-€2499	180.974	−97.432 - 459.381
€2500-€2999	152.990	−137.689 - 443.668
€3000-€4999	14.816	−312.651 - 342.282
>€5000	−230.385	−632.175 - 171.404

b, unstandardised regression coefficient: change in PA MET.Mins.Wk^{-1}, per one unit change of variable. Statistical significance of the regression coefficients as determined by *p*-value: <0.001†, ≤0.01‡ , <0.05¥

5.3.2. Multiple Linear Regression Models for Predictors of PA

The overall regression equation was significant $F(6, 3689) = 69.553$, $p<0.001$, $R^2 = 0.1$ (Table 15). Following a step-wise elimination, six significant predictors were identified; 1) Number of fitness centre visits, 2) age (younger), 3) sex (male), 4) visit duration, 5) education level (secondary school) and 6) civil status (married). When these predictors were taken as a set they accounted for 10% of the variance in PA ($R^2 = 0.1$). Participants' predicted PA was equal to 3122.123 + 69.428 (visits) – 33.173 (Age) + 684.157 (Sex) + 7.03 (Visit Duration) + 574.917 (secondary school education) – 221.165 Met.Mins.Week^{-1} (Married), where visits were measured in number of visits per month, age in years, sex as 1 = female and 2 = male, and visit duration in minutes. Individually each predictor was statistically significant and accounted for a unique variance in PA which the other variables did not: visits per month (standardised coefficients Beta = 0.172, $p<0.001$); age (standardised coefficients Beta = –0.144, $p<0.001$); sex (standardised coefficients Beta = 0.12, $p<0.001$); average visit duration (standardised coefficients Beta = 0.10, $p<0.001$); secondary education (standardised coefficients Beta = 0.07, $p<0.001$); married (standardised coefficients Beta = –0.04, $p=0.021$).

Table 15: PA, Met.Mins.Week^{-1} (n=3689); (unadjusted $R^2 = 0.1$, Adjusted $R^2 = 0.1$)

	b	**Std. Error**	**95% CI**	**Sig.**
(Intercept)	3122.123	212.544	2705.406 - 3538.839	<0.001
Visits per Month	69.428	6.957	55.788 - 83.067	<0.001
Age	–33.173	3.947	–40.911 - –25.435	<0.001
Sex	684.157	87.347	512.903 - 855.411	<0.001
Visit Duration	7.03	1.165	4.747 - 9.314	<0.001
Secondary	574.917	127.967	324.024 - 825.811	<0.001
Married	–221.165	95.713	–408.820 - –33.510	0.021

5.3.3. Association between Motives and Fitness Centre Visits

Prior to the regression analysis, a Kruskal-Wallis non-parametric ANOVA reported a significant interaction between monthly fitness centre visits and motives (p<0.001), (Table 16). A pairwise DSCF post-hoc analysis reported members whose main objective was to "*keep fit & feel good*" visited the centre significantly more times in a month than members whose motives were; "*control and reduce weight*", "*watch health and evade physical problems*" and "*relieve stress*" (p<0.001; figure 20).

Table 16: Monthly Fitness Centre Visits by Motive

Motives	***N***	**Visits Per Month (Mean ± SD)**
Control & Reduce Weight	510	6.87 ± 6.55[¥]
Watch My Health & Evade Physical Problems	934	8.06 ± 7.94[¥]
Have Fun & Meet People	16	9.81 ± 8.99
Relieve Stress	238	7.39 ± 8.02[¥]
Keep Fit & Feel Good	2004	9.36 ± 7.94
Improve Physical Appearance	374	8.47 ± 8.06
Other Objectives	66	7.82 ± 6.73

[¥]Significant difference with "Keep Fit & Feel Good", p < 0.001

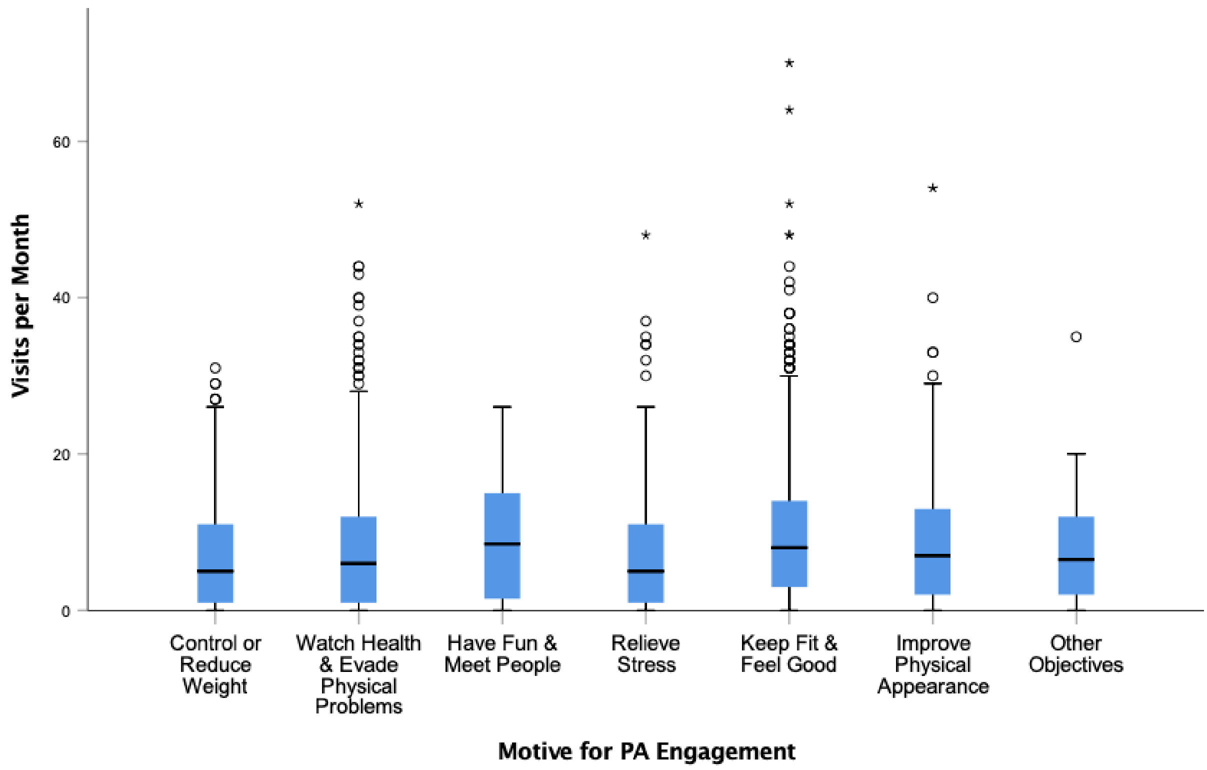

Figure 20: Simple box plot; Fitness Centre Members' Visits per month by Motives for Engaging in Physical Activity

5.3.4. Independent Predictors of Fitness Centre Visits

Univariate linear regression analysis is presented in table 17. Age (younger) and sex (male) were significantly associated with increased fitness centre visits (b=0.03, p=0.006), and (b=11.463, p<0.001), respectively. Employment status (student) (b=−0.199, p=0.021) and level of education (university or higher) (b=−0.315, p=0.004) also reported a significant association with fitness centre visits. Visit duration (b=0.08, p<0.001) and attendance of group exercise classes (b=0.646, p<0.001) was positively associated with increased fitness centre visits. Motives (physical appearance and keep fit & feel good) were also significantly associated with fitness centre visits (b=0.426, p<0.001). No associations were found between fitness centre visits and fitness centre location, civil status, income or membership length for fitness centre visits.

Table 17: Univariate regression analysis of fitness centre visits in the study population

Variables	*b*	95% CI
Age	0.007	−0.009 - 0.024
Sex	1.909	1.515 - 2.302†
Membership Duration	−0.013	−0.022 - −0.003¥
Visit Duration	0.061	0.056 - 0.066†
Group Exercise Classes	0.531	0.489 - 0.572†
Houseworker	0.847	−1.207 - 2.9
Self-Employed	−0.869	−2.12 - 0.382
Student	−0.91	−2.249 - 0.429
Retired or Disabled	0.157	−1.23 - 1.544
Employed	−1.069	−2.153 - 0.014
University or Higher	−0.826	−1.487 - −0.166¥
Secondary / baccalaureate	0.058	−0.806 - 0.922
Primary or Less	0.363	−1.913 - 2.640
Married	0.226	−0.383 - 0.835
Divorced	0.612	−0.5 - 1.724
Single	0.553	−0.111 - 1.216
Widow	−1.711	−3.987 - 0.565
€500-€999	−0.311	−1.057 - 0.435
€1000-€1499	0.999	−0.015 - 2.013
€2000-€2499	−0.799	−1.514 - −0.083¥
€2500-€2999	−0.272	−1.029 - 0.486
€3000-€4999	0.249	−0.593 - 1.091
>€5000	0.190	−0.926 - 1.305
Improve Physical Appearance	1.536	0.591 - 2.482†
Keep Fit & Feel Good	2.323	1.682 - 2.965†
Watch Health	0.888	0.153 - 1.624
Have Fun or Other Motives	1.3	−0.425 - 3.026

b, unstandardised regression coefficient: change in number of fitness centre visits per month, per one unit of change of variable. Statistical significance of the regression coefficient as determined by *p*–value: ≤0.001† , ≤0.01‡ , <0.05¥

5.3.5. Multiple Linear Regression Models for Predictors of Fitness Centre Visits

The second overall regression equation predicting monthly fitness centre visits was significant, $F(5, 4065) = 369.275$, $p<0.001$, $R^2 = 0.31$ (Table 18). The stepwise elimination regression produced five significant predictors of fitness centre visits; 1) longer visit duration, 2) group exercise attendance, 3) sex (male), 4) motive (keep fit & feel good) and 5) increased membership duration.

This model accounted for 31% of the variance in fitness centre visits. Participants' predicted fitness centre visits was equal to –0.728 + 0.061 (visit duration) + 0.524 (exercise classes) + 1.888 (sex; male) + 0.856 (motive; Keep fit & feel good) – 0.013 (increased membership duration), where sex was coded as 1 = female and 2 = male and motive is coded as 1 = keep fit and feel good, and all other motives = 0, and the reference motive was control and reduce weight. These figures corresponded to fitness centre visits increasing by 0.061 visits for each minute of visit duration, 0.524 visits for each exercise class attended, and males 1.888 more visits per month than females. Members whose motive was to keep fit and feel good visited 0.856 times per month more than members whose motives were control and reduce weight. Fitness centre visits decreased by 0.013 visits per month with increasing membership duration.

Individually, each predictor was statistically significant at predicting a unique variance in fitness centre visits: visit duration, standardised coefficients Beta = 0.34; group exercise classes, standardised coefficients Beta = 0.35; sex, standardised coefficients Beta = 0.12; motive, standardised coefficients Beta = 0.06, ($p\leq0.001$); membership duration, standardised coefficients Beta = –0.03, ($p=0.009$).

Table 18: Fitness Centre Visits (per month) (*n*=4065); (unadjusted R^2 = 0.31, adjusted R^2 = 0.31)

Variables	*b*	Std. Error	95% CI	Sig.
(Constant)	−0.495	0.373	−1.227 - 0.236	0.184
Visit Duration (mins)	0.061	0.002	0.056 – 0.066	<0.001
Exercise classes	0.524	0.021	0.482 - 0.565	<0.001
Sex (Male)	1.888	0.200	1.495 - 2.281	<0.001
Keep Fit & Feel Good	0.856	0.199	0.465 - 1.246	<0.001
Membership Duration	−0.013	0.005	−0.022 - −0.003	0.009

5.3.6. Independent Predictors of Fitness Centre Membership Duration

Univariate linear regression analysis for independent predictors of fitness centre membership duration is presented in table 19. Younger age was significantly associated with fitness centre membership duration (*b*=0.396, *p*<0.001). Monthly fitness centre visits (*b*=−0.124, *p*=0.012) and number of group exercise classes attended (*b*=0.677, *p*<0.001) reported a significant association with membership duration. Employment status of self-employed, student or employed were found to be significant independent predictors of membership duration (table 19). The motive "Keep fit & feel good" also reported a significant association with membership duration; (*b*=3.000, *p*<0.001); no other motive responses were statistically significant.

Table 19: Univariate regression analysis of fitness centre membership duration in the study population

Variables	*b*	95% CI
Age	0.396	0.346 - 0.446†
Sex	1.143	−0.107 - 2.393
Visits per Month	−0.124	−0.221 - −0.028¥
Average Visit Duration (mins)	−0.014	−0.036 - −2.296¥
Group Exercise Classes	0.470	0.141 - 8.194†
Houseworker	4.303	−1.242 - 9.847
Self-Employed	−4.104	−7.480 - −0.727¥
Student	−11.853	−15.468 - −8.238†
Retired or Disabled	0.431	−3.313 - 4.176
Employed	−3.358	−6.283 - −0.433¥
University or Higher	3.627	1.829 - 5.424†
Secondary / baccalaureate	2.187	−0.164 - 4.537
Primary or Less	4.423	−1.768 - 10.613
Married	6.415	4.781 - 8.050†
Divorced	5.504	2.519 - 8.489†
Single	−1.222	−3.004 - 0.560
Widow	2.797	−3.314 - 8.907
€500-€999	2.584	0.565 - 4.604¥
€1000-€1499	−3.512	−6.257 - −0.766¥
€2000-€2499	−1.057	−2.995 - 0.881
€2500-€2999	1.139	−0.913 - 3.191
€3000-€4999	2.151	−0.130 - 4.431
>€5000	8.460	5.439 - 11.480†
Improve Physical Appearance	−2.246	−4.828 – 0.336
Keep Fit & Feel Good	3.000	1.247 – 4.752†
Watch Health	1.964	−0.045 – 3.973
Have Fun or Other Motives	−0.443	−5.155 – 4.270

b, unstandardised regression coefficient: change in number of fitness centre visits per month, per one unit of change of variable. Statistical significance of the regression coefficient as determined by *p*–value: ≤0.001† , ≤0.01‡ , <0.05¥

5.3.7. Multiple Linear Regression Models for Predictors of Fitness Centre Membership Duration

The overall multiple regression equation predicting membership duration was significant, $F(7, 4063) = 58.311$, $p<0.001$, $R^2 = 0.09$ (Table 20). The stepwise elimination regression produced a model of seven significant predictors of membership duration these were; age, group exercise class attendance, household monthly income over €5000 per month, university education or higher, married, monthly fitness centre visits and the motive of keep fit & feel good.

This model of predictors accounts for 9% in the variance of fitness centre membership duration. The members in this population's predicted membership duration is equal to 2.24 months + 0.35 (as age decreases) + 0.625 (increased group exercise class attendance) + 5.747 (household monthly income >€5000) + 2.718 (university or higher education) + 2.698 (married) – 0.14 (increased visits) + 1.401 months (motive, keep fit & feel good).

Each of the variables in the final model were statistically significant predictors individually for a unique variance in membership duration: age, standardised coefficients Beta = 0.21 ($p<0.001$); group exercise attendance, standardised coefficients Beta = 0.15 ($p<0.001$); income >€5000, standardised coefficients Beta = 0.06 ($p<0.001$); university or higher, standardised coefficients Beta = 0.06; married, standardised coefficients Beta = 0.065 ($p<0.001$); monthly visits, standardised coefficients Beta = –0.052 ($p=0.002$); keep fit & feel good, standardised coefficients Beta = 0.034, ($p=0.025$).

Table 20: Multiple Linear Regression Model for predicting fitness centre membership duration

Variable	*b*	Std. Error	95% CI	Sig.
(Constant)	2.240	1.296	–0.301 - 4.782	0.084
Age (Years)	0.350	0.028	0.295 - 0.404	<0.001
Group Exercise Classes	0.625	0.068	0.491 - 0.759	<0.001
Income >€5000	5.747	1.444	2.917 - 8.578	<0.001
University or Higher	2.718	0.679	1.387 - 4.050	<0.001
Married	2.698	0.688	1.350 - 4.046	<0.001
Monthly Visits	–0.140	0.045	–0.229 - –0.52	0.002
Keep Fit & Feel Good	1.401	0.626	0.175 – 2.627	0.025

5.3.8. Independent Predictors of Group Exercise Class Attendance

Univariate linear regression analysis predicting the number of group exercise classes attended per month for fitness centre members in the study population is presented in table 21. Sex, visits per month, average visit duration and membership duration were all significant predictors of the number of group exercise classes attended (p>0.001). Employment statuses of houseworker (p=0.016) and student (p=0.003) were significant independent predictors. No response regarding educational level or civil status were a statistically significant predictor of group exercise class attendance. A monthly household income of €1000-€1499 or €2000-€2499 was a statistically significant predictors of group exercise classes attended (p=0.031, p=0.037). The motive ‘keep fit & feel good’ was a significant predictor of group exercise class attendance (p<0.001).

Table 21: Univariate regression analysis of number of group exercise classes attended in the study population

Variables	*b*	95% CI
Age	0.004	−0.007 - 0.015
Sex	−1.694	−1.965 - −1.424†
Visits per Month	0.254	0.234 - 0.274†
Average Visit Duration (mins)	0.015	0.011 - 0.018†
Membership Duration	0.033	0.026 - 0.040†
Houseworker	1.656	0.304 - 3.009¥
Self-Employed	−0.484	−1.308 - 0.339
Student	−1.346	−2.228 - −0.464‡
Retired or Disabled	−0.198	−1.111 - 0.715
Employed	−0.675	−1.389 - 0.038
University or Higher	0.030	−0.406 - 0.466
Secondary / baccalaureate	−0.111	−0.681 - 0.460
Primary or Less	−0.773	−2.276 - 0.731
Married	0.143	−0.259 - 0.545
Divorced	0.669	−0.064 - 1.403
Single	0.149	−0.289 - 0.587
Widow	0.304	−1.198 - 1.806
€500-€999	0.026	−0.466 - 0.518
€1000-€1499	0.734	0.066 - 1.403¥
€2000-€2499	−0.502	−0.974 - −0.030¥
€2500-€2999	−0.139	−0.639 - 0.360
€3000-€4999	−0.108	−0.664 - 0.447
>€5000	0.002	−0.734 - 0.737
Improve Physical Appearance	−0.204	−0.828 - 0.421
Keep Fit & Feel Good	0.846	0.422 - 1.270†
Watch Health	−0.107	−0.594 - 0.379
Have Fun or Other Motives	−0.702	−1.842 - 0.438

5.3.9. Multiple Linear Regression Predicting Group Exercise Class Attendance

The overall multiple regression equation predicting group exercise class attendance was significant, $F(6, 4064) = 217.787$, $p<0.001$, $R^2 = 0.24$ (Table 22). The stepwise elimination regression produced a model of six significant predictors of group exercise class attendance, these were; number of visits per month, sex - male, increased membership duration, greater average duration of a visit to the fitness centre, the motive of “keep fit & feel good” and being a student.

The overall predictor model accounted for 24% in the overall variance of group exercise classes attended. The number of group exercise classes attended was equal to 1.11 + 0.25 (visits per month) – 1.72 (sex, male) + 0.03 (membership duration) + 0.02 (visit duration) + 0.43 (motive: keep fit & feel good) –0.68 (student).

Individually, each predictor was reported to have predicted a unique variance in the number of group exercise classes attended, which were as follows: visits per month, standardised coefficients beta = 0.38 ($p<0.001$); sex, standardised coefficients beta = –0.17 ($p<0.001$); membership duration, standardised coefficients beta = 0.13 ($p<0.001$); average visit duration, standardised coefficients beta = 0.12 ($p<0.001$); keep fit & feel good, standardised coefficients beta = 0.04 ($p=0.002$); student, standardised coefficients beta = –0.04 ($p=0.008$).

Table 22: Multiple Linear Regression Model for predicting group exercise class attendance

Variable	*b*	Std. Error	95% CI	Sig.
(Constant)	1.111	0.261	0.600 - 1.622	<0.001
Visits per Month	0.251	0.010	0.231 - 0.271	<0.001
Sex	–1.715	0.138	–1.985 - –1.445	<0.001
Membership Duration	0.032	0.003	0.025 - 0.038	<0.001
Visit Duration	0.015	0.002	0.011 - 0.018	<0.001
Keep Fit & Feel Good	0.426	0.138	0.155 - 0.696	0.002
Student	–0.68	0.258	–1.186 - –0.175	0.008

5.4. Discussion

This study aimed to investigate the predictors of PA engagement in a sample of public fitness centre members. From the literature, it is thought that this is the first study to investigate predictors of PA levels in fitness centre members in Spain. The current study demonstrated the effective utilisation and analysis of data collected in fitness centre's annual surveys, and how it can be used to predict PA behaviour. The data outline those most likely to participate in greater PA behaviour, sustain membership for longer durations, and engage in specific activities in the centre such as group exercise classes.

The sample of fitness centre members in the current study is large compared with other studies in this area (Riseth et al., 2019, Gjestvang et al., 2019, Schroeder et al., 2017). These data can be used as a bench-mark for future research in PA behaviour of fitness centre members. These data provides insight into numerous variables across demographic and socioeconomic characteristics as well as physical activity behaviour, which have not been collected on this scale before.

5.4.1. Predictors of Physical Activity

The regression analyses in the current study reported statistically significant models for predictors of PA, number of fitness centre visits per month, membership duration and group exercise class attendance. The model predicting greater PA consisted of more visits, younger age, being male and a greater visit duration. This model was statistically significant, although it was responsible for only 10% of the variance in PA. Other research from Simmons et al. (2010) included alcohol consumption and baseline fitness level was able to predict upwards of 32% of the variance in change in PA. Although, it was noted that baseline fitness level accounted for most of the variance explained in their model. Conversely, other research by Kilroy (2018) predicting PA reported models explaining 7-11% using predictors of age, gender, education and health-related variables, further supported by Hart (2018) which predicted PA with socioeconomic variables, age, gender and ethnicity. It might be suggested that an r^2 value of 10% may indicate that other predictors are involved. However, considering that PA was measured as MET minutes per week, a 10% variance could potentially account for the difference between PA classifications as per the UK Chief Medical Officer recommendations (Davies et al., 2019). Previously, socio-economic variables have been shown to predict PA engagement levels (Hankonen et al., 2017), although no socio-economic factors were present in this multiple regression model. However, income, education level and employment status were significant predictors in the univariate regression analysis of independent predictors of PA. These were eliminated in the step-wise regression analysis process. It might be that these factors have less impact in the variability of PA levels in cohorts of fitness centre members. As the previous chapter suggested, GO fit members are likely to have similar level of income, and similar education level. Hence, these are perhaps not unique predictors in this population. It is also possible that this sample is not representative of all fitness centre members, particularly those from cheaper public fitness centres or with different facilities.

In the multiple regression model for PA, being male was found to be a significant predictor of engaging in greater PA. Sex differences in PA have been explored previously, with males consistently being reported as more active than females (Hands et al., 2016). Sex differences in PA behaviour may support the possibility that female's requirements for exercise and exercise environment might be different to that of males (Hands et al., 2016). Despite recent progress in exercise options, it may be that more female-specific exercise options are required in fitness centres, for example group exercise classes, which were shown to be undertaken significantly more by females than males.

In general it is not yet clear if sex may affect the health-related outcomes of exercise, and there is a lack of studies reporting outcomes for sexes separately. It has been suggested that health outcomes associated with body composition and insulin resistance, as a result of PA, may differ between sexes (Kuk and Ross, 2009, Geer and Shen, 2009). Hence, this should be a consideration of exercise prescription (Huxley, 2007). Differences in insulin sensitivity could be due to fat distribution, whereby typically men have a central fat distribution and women a peripheral distribution, which has been associated with an improved insulin sensitivity (Snijder et al., 2004). Further research could investigate the sex differences in motives for PA, which was shown to be a predictor for greater PA engagement. Programmers of exercise initiatives should consider aligning interventions with significant predictive motives. Specifically with regards to motives and sex, can foster enhanced commitment to exercise programmes (Vallerand and Young, 2014).

Despite the exercise and motive-related factors for predicting PA behaviour, there are still many non-exercise related issues which affect female participation in PA. Sex differences in PA engagement, may also be associated with parental responsibilities. Previous reports have outlined a significant difference between mothers and fathers in leisure time PA. It has been reported that once women become mothers their PA levels fall. Motherhood could be a possible explanation for the differences in PA levels between sexes in this study, and why being male was a predictor of greater PA engagement. Information on motherhood was not available from the survey, although the demographics of the population suggest many would be mothers (Berge et al., 2011, Hesketh et al., 2014). There are also societal pressure which females exclusively face with regards to exercise including motives for exercise as well as issues in communal environments which affect PA behaviour (Brabazon, 2006, Craig and Liberti, 2007).

5.4.2. Predictors of Fitness Centre Visits

A greater amount of fitness centre visits was predicted by; duration of visits, attendance of group exercise classes, sex and the motive of '*keep fit and feel good'*. Previous research in Spain has found that a lower frequency of fitness centre visits predicted likeliness of drop-out from fitness centre membership (Clavel San Emeterio et al., 2020). Thus, it could be suggested that efforts to enable an increased visit frequency could help decrease the likeliness of drop-out. However, this would be a multi-factorial approach, considering social cognitive and behavioural theories, and accessibility issues including socioeconomic factors, such as leisure time availability, child care facilities and affordable transport. It is likely that the greatest impact would come from behaviour change strategies to support those who lack internally regulated motivation, as supported by the previous chapters of this thesis.

The model for fitness centre visits included motives, which has previously been shown to predict exercise engagement and membership abandonment in fitness centres (Vallerand and Young, 2014). The motive "*Keep fit & feel good*" was most frequently reported in the current population, as shown in chapter four. Hence, this supports the models predicting increased visits, membership duration and group exercise class attendance, which included the motive, '*Keep fit & feel good'* as a predictor. It has been reported previously that motives which are extrinsically focused such as '*improve physical appearance*' or '*watch health*' are less likely to provide sustained engagement in PA. An externalised locus of causality from Self-Determination Theory, is less favourable than an internal locus such as integrated regulation as this has been associated with less sustained PA engagement (Duncan et al., 2010). Increased PA in Internally motivated individuals is supported in the present study with only the '*keep fit & feel good*' motive being a significant predictor of fitness centre visits in a population. as Chapter four also supports this reporting GO fit members were significantly more active than the general population.

Attendance to group exercise classes predicted increased fitness centre visits. The regression model accounted for approximately 30% (r^2 = 0.3) of the variance in fitness centre visits. Hence, the growing popularity of group exercise classes which was outlined by fitness trend reports, is supported by this study. It is suggested that exercise classes can be a useful medium through which fitness centre engagement can be increased (Batrakoulis, 2019, Thompson, 2019). In a study by Vallerand and Young (2014), it was reported that social-affiliation was a predictor of commitment to exercise. Group exercise classes can create an environment of a collective social group performing exercise together and therefore potentially improve commitment to exercise interventions. Group affiliation could improve retention and adherence to programmes as well as potentially provide long-term, sustained PA behaviour (Wing and Jeffery, 1999). Exercising as part of a group has been shown to have psychosocial benefits as evidenced in a review by Eime et al. (2013). It can also provide social connectedness, support and bonding which is associated with health benefits and exercise adherence (Kanamori et al., 2016, Farrance et al., 2016). The study by Kanamori et al. (2016) reported that group exercise was performed by younger individuals with higher educational attainment and equivalised income, who lived with others. Other research has identified that groups provide an element of 'social competition' with the most active participants, triggering a process of increasing the activity levels of other group members (Zhang et al., 2016). It was also reported that members who are 'competition motivated' have a much greater attendance, which further supports the inclusion of group exercise options in initiatives aiming to improve PA behaviour.

5.4.3. Predictors of membership duration

The model predicting membership duration was the only analysis within this study which included income as a significant predictor. The highest amount of monthly, household income (>€5000 per month) predicted longer membership duration. This may suggest that such financial expenditure is necessary for long-term PA engagement and increased PA behaviour, which has been previously reported in a reviews (O'Donoghue et al., 2018, Kari et al., 2015, Kim and So, 2014, Stalsberg and Pedersen, 2010). However, Stalsberg and Pedersen (2010) discussed that 42% of studies reported an opposite or no relation between income and PA. It is possible that the current population contains bias regarding income and socioeconomic status, which would influence the prediction of membership duration.

Using information regarding motives can be beneficial in retaining members beyond the first year of fitness centre membership and in designing initiatives to increase engagement. Long-term PA engagement being associated with motive is supported in the multiple regression model predicting increased membership duration with "*keep fit & feel good*" being a significant predictor. Previous research has shown how intrinsic motives (or more towards intrinsic on a scale) can predict enhanced PA behaviour (engagement and retention). The "*feel good*" aspect of the motive included in the model would support this with the connotation of feeling within one's self, internally regulating motivation, explained by self-determination theory and as a predictor of long-term PA behaviour (Wilson et al., 2008). Further, the "*keep fit*" is considered as both intrinsic and extrinsic motivation. Depending on whether this is to satisfy an external stimulus, such as achieve a fitness goal to make a sports team, or an internally regulated decision. If external, then this could contribute to a shorter membership duration once their fitness-oriented goal is achieved (Vallerand and Young, 2014).

5.4.4. Predictors of Group Exercise Class Attendance

Group exercise classes have become an increasingly popular form of physical activity in recent years (Rustaden et al., 2020). Group exercise class attendance was a predictor of PA in the current study and, therefore, it is important to understand the predictors of attending group exercise classes. The analysis outlined that significant predictors were; visits, sex (female), membership durations, the motive 'keep fit & feel good' and being a student. Income levels were found to be independent predictors of group exercise class attendance although these were eliminated from the multiple regression model.

High income and socioeconomic status has been associated with high PA levels, however this relationship is complex and the literature is not uniform (Gordon-Larsen et al., 2000, Klavestrand and Vingård, 2009, Talaei et al., 2013). Student status was predicted increased attendance in group exercise classes. It might be suggested that these participants have time-flexible occupations, and are also part of a younger generation which are more attracted to group exercise classes and exercising as part of a group. Again, the motive '*keep fit & feel good*' was a significant predictor of group exercise class attendance, suggesting that the characteristics of group exercise classes contribute to the motive of "*feeling good*" or as an effective fitness-improvement option. This may be fuelled by the participation of exercise with others, providing external, supportive stimulus. Both of these factors are supported by findings from Patterson et al. (2019) which suggest there is a connection between group exercise class attendance, activity behaviour of peers, and anxiety levels in college students. Furthermore, the group exercise dynamic has a relation to the basic psychological needs theory in self-determined motivation and enjoyment in exercise. A study by Murcia et al. (2008) showed that exercising in a 'peer motivational climate' such as a group exercise class, predicted the three basic psychological needs, which in turn, predicted self-determined motivation, and therefore enjoyment, during the activity. It has also been reported by Chung et al. (2017), that PA levels between friends are similar and positively related to the friends' encouragement to being physically active.

5.4.5. Relationships between predictors and other predictors of PA engagement

Outlined by the various models is the proposed symbiotic relationship between a higher number of visits per month, a greater visit duration and a greater membership duration, which feature as significant predictors in the final regression models for each analysis. Fitness centres can utilise this information to maintain members in more sustained PA behaviour as well as amend current exercise options to improve accessibility. For example, this could be creating women-only classes, increasing capacity of classes, or putting on more classes at different times for members with less flexible leisure-time PA availability.

Whilst this chapter outlines significant models for predicting various PA behaviour, these models still leave a large proportion of the variability in question. Whilst one explanation could be that this population is mostly quite similar (as outlined in the previous chapter), with around 70% of the population sharing a similar income, education level and employment status, other possibilities remain regarding the outstanding variability. A study by Simmons et al. (2010) investigated predictors of PA energy expenditure with a model of baseline PA, sex and fitness which explained 39% of the variance in change of PA energy expenditure in individuals with increased risk of type 2 diabetes. Their findings may suggest that some of the variance can be explained by the baseline PA levels and fitness. It is likely that the baseline fitness and PA levels of the current population are very similar and this perhaps dilutes associations of these factors as predictors of PA. Whilst the explained variance in the present models may seem low, they may still account for a clinically significant amount of PA associated with CVD risk, and other studies have reported similar findings (Eriksson et al., 2012, Kilroy, 2018). For example, the model predicting PA explained a 10% variance in PA levels. Since this could be a sufficient amount to change PA classification from meeting the CMO guidelines to being ‘highly active’, this may decrease CVD risk. By reducing risk factors, and consequently healthcare visits and the public health services and economic burden. Previous research by Pandey et al. (2017) has shown that achieving above the recommended dosage of PA (>1000 MET-Min/Week) was associated with a greater reduction in the risk of heart failure (22%), more than low levels (6% lower risk, <500 MET-Min/Week), and the recommended dosage of PA (11% lower risk, 500-1000 MET-Min/Week). Other research has shown that health status and physical functioning are predictors of PA and group exercise class attendance, which were not included as predictors in the present study (Tiedemann et al., 2012, Weiss et al., 2007).

This chapter improves the understanding of predictors of fitness centre PA behaviour compared to the general populations of Spain and Europe outlined in the previous chapter. There were concordant predictors of PA in fitness centre members and the general population, with the absence of income. However, this study outlines unique predictors associated with the fitness centre such as increased visits and group exercise class attendance. Equally, it is interesting to understand what factors were not significant predictors of PA engagement within this population of fitness centre members. Within the three regression models for PA, fitness centre visits, and group exercise classes, predictor variables associated with socioeconomic status were less prevalent. The final model of predictors for PA contained '*secondary*' school education, and occupation of '*student*' was a predictor in the final model for group exercise class attendance. This would suggest that the other factors are greater predictors of PA engagement within this population, although it could be proposed that this population has relatively moderate to high socioeconomic status with regards to education level, occupation and income.

No motives other than '*keep fit & feel good*' were reported as significant predictors for any of the PA engagement models. Previous reports have discussed the impact physical appearance has on the behaviour of individuals in today's society, though this was not a predictor of PA behaviour in this population. However, the motive question only allowed for one response, and so it could have been a secondary motive had multiple responses been allowed. Another possibility is that this population was older than those expected to be motivated by physical appearance i.e. females and students (Prichard and Tiggemann, 2008, Prichard and Tiggemann, 2005). Furthermore, the response, '*have fun or other motives*' was not a significant predictor of PA levels, hence whilst it may be an outcome of engaging in PA for some individuals, it does not necessarily result in increased PA behaviour. Again, it could have been a secondary motive for some members, though it may be surprising given that group exercise class attendance was a predictor and one of the factors associated with group exercise is enjoyment from the peer group dynamic (Graupensperger et al., 2019).

5.5. Limitations

There are several limitations to this study. Firstly, the questionnaire administered was not specifically aimed at addressing the predictors of PA and therefore may not have captured all the variables associated with predicting PA. Secondly, it would have been beneficial to have had a complete set of responses from all members as this would have allowed analyses between all variables, such as PA and motive. The use of the short form IPAQ in this study may be questioned due to its' possible overestimation of

PA levels (Lee et al., 2011). However, as previously mentioned, this tool is a widely used questionnaire within this area of research, and is short, and both time- and cost-effective for both the participants and research team. The results regarding motives only allowed for a single response from fitness centre members, which may have been limiting for participants who would have chosen multiple responses. Further, there were not as many response options as other studies have provided (Knowles et al., 2015, Tylka and Homan, 2015). Considering that the motive predicting PA could be considered as both intrinsic and extrinsic (‘*keep fit & feel good’*), it may be beneficial to include options that are more specific or include elements of validated motive responses for PA i.e. exercise motivations inventory (Markland and Hardy, 1993). Hence, this would distinguish between goal-oriented (keep fit or other fitness parameter-based goals), and self-perceived motives associated with feelings of one-self. These have been shown to have associations with short and long-term engagement with PA behaviour (Vallerand, 2007). However, it is acknowledged that not all exercise behaviour motivations fit into the dichotomy of simply intrinsic and extrinsic (Cho et al., 2020). Whilst fitness centre visits may indicate engagement with the centre they may not necessarily always include PA. Centres include many other facilities such as health and nutrition support, physiotherapy and outdoor swimming pools. Hence, future investigations should aim to understand the specific activity being undertaken at the centre for each visit, as this was not recorded in the present study or previous chapter.

There are some limitations to using multiple regressions analyses, although these usually consist of data issues. For example, outliers in the data can influence the regression slope as a result of the distance from the rest of the data and because of this the Mahalanobis was performed. Furthermore, violations of homoscedasticity and collinearity were tested during the statistical analysis and hence the data was not affected by these, and there were very few exclusions.

5.6. Conclusion

Physical activity is influenced by many factors including environmental, psychological, social and exercise tolerance (Tsujimura et al., 2018). This study presents models containing many of these factors which predicted greater engagement in PA, including fitness centre visits, membership duration and group exercise class attendance. The study provides evidence that large scale questionnaire data can help understand PA behaviour of fitness centre members. Amongst the predictor variables, a prevalent observation was the inclusion of other exercise behaviour within the predictor models. For example, number of visits and membership duration was a significant predictor of group exercise classes attended per month; number of group exercise classes attended per month was a predictor for number of fitness centre visits and duration of membership. Sex also predicted PA behaviours with males predicting increased PA behaviour. Although, females were observed to predict PA behaviour in the form of group exercise class attendance.

The models in the current study, suggest that further research should investigate the effects of motives and attending group exercise classes as these appear to influence PA behaviour in fitness centre members. However, this is a preference amongst females, and possibly a reason for sign-up and attendance. Further, this may be a predictor but not necessary a facilitator of greater PA. It would be beneficial to perform similar analyses in other populations of fitness centre members of various price points, and geographic locations, to investigate if predictors are consistent across Spain and Europe and in populations of various socioeconomic status. Further investigation into the barriers and facilitators of PA in other fitness centre members such as environmental factors, aside from the predictors of being male and having a higher socioeconomic status, found in the present study. This would help understand the associations with increased PA behaviour in these populations.

The current study reported significant predictor models for the engagement of PA in members, in Spanish fitness centres. PA behaviours such as visit frequency and duration and group exercise classes can predict increased PA behaviour and more sustained PA behaviours. These findings can be compared with other PA options to improve CVD risk factors and overall health. It is also useful for initiatives to target current members and develop their engagement in PA to make them sustained, long-term engagers in PA. Whilst fitness centre members are reported to engage in greater PA behaviour, it is unclear whether this PA behaviour has beneficial effects to CVD risk factors, or whether this PA is as effective as the exercise recommendations for reducing CVD risk.

Chapter 6. The Effects of Usual Exercise Behaviours and Structured Exercise at Improving CVD Risk Factors in Inactive Public Fitness Centre Members

6.1. Introduction

Chapters 4 and 5 placed the characteristics and PA behaviours of fitness centre members within the context of the general population, and reported the predictors of engaging in greater PA behaviour. Findings indicated that fitness centre members are more active than the general population, and potentially "highly active" according to IPAQ classification and PA guidelines. Engagement with a fitness centre was also a predictor of greater PA. However, there is a population of fitness centre members who do not achieve the PA guidelines, despite fitness centre membership. Chapter 4 showed that 9% of GO fit members reported "low" PA behaviour, and cross-sectional studies have found that 6-13% of fitness centre members do not achieve the PA guidelines (Ready et al., 2005). Another study reported average fitness centre attendance of less than one visit (0.6) per week (Charness and Gneezy, 2009). There is the potential of some dormant members and very infrequent visitors who are also physically inactive (Gjestvang et al., 2020b, Della Vigna and Malmendier, 2006). Hence, it is important to investigate the influence of exercise modality on health outcomes to understand whether this is as effective at improving CVD risk factors as the current recommendations from the ACSM.

Studies using fitness centre members are underrepresented in the literature. Despite members possessing the predictors of engaging in high levels of PA, and having access to facilities, this group may be at a higher CVD risk due to physical inactivity (Sánchez-Oliver et al., 2018). Spain has reported a significant CVD public health issue, particularly with cases associated with physical inactivity (Fussenich et al., 2016, WHO, 2016). The financial burden of treating CVD is forecast to be almost €8.8 bn in 2020 (Bernick and Davis, 2014). It is therefore important to investigate whether the exercise behaviours of members are sufficient in providing positive health outcomes, in order for the health of populations to improve.

Fitness centres are being called upon to be the hub of active communities, a focus must be placed on this population and their PA, as outlined in the previous chapters. However, simply knowing members visit the centre is not sufficient when trying to understand the impact their PA behaviour has on overall CVD risk factors. Therefore, the behaviour of fitness centre members within the centre is important in understanding the popularity of various exercise options, adherence and long-term, sustained active lifestyles.

The systematic review in chapter two analysed studies with varying modality, duration and intensities of exercising interventions, with many demonstrating positive outcomes to CVD risk factors. It is generally considered that interventions with combined aerobic and resistance training are most effective at improving multiple risk factors (Mann et al., 2014, Sousa et al., 2013, Schroeder et al., 2019, Schwingshackl et al., 2013). Structured combined exercise interventions like those described by the American College of Sport Medicine (ACSM) have previously been shown to improve CVD risk profiles (Dobrosielski et al., 2012, Dunn et al., 1997, Greenwood et al., 2015, Stewart et al., 2005). However, much of the literature on structured exercise and fitness centre based interventions incorporate supervision, which may not be representative of a usual exercise environments (Pereira Neiva et al., 2018, Reljic et al., 2018, Vidoni et al., 2015).

Clinical studies do not translate well as real-world studies, reporting much lower adherence and retention rates. For example, Mann et al. (2016), conducted an exercise intervention in public fitness centres across England and reported a retention of 32%. This study utilised the programme prescribed by the ACSM and made it accessible to members of the public. Similar studies have not been conducted in Spain, and would provide insight into the effectiveness of these interventions in Spanish fitness centres.

The review of literature in chapter two showed the need for more research investigating CVD risk across Europe. Further, there is a need for real-world interventions which are unsupervised, and enrol at-risk but otherwise healthy, participants such as inactive fitness centre members. This makes findings more applicable to real world public health initiatives when scaled up. It is important to find ways of replicating the results from lab-based studies in real-world settings, by utilising the existing resources such as members in leisure centres. This population has shown a commitment to be active by purchasing a fitness centre membership and yet with physically inactive. Hence, by investigating exercise programmes in these settings and populations, it is possible to understand the real-world effectiveness of interventions rather than the efficacy alone (Beedie et al., 2015).

The previous experimental chapters highlighted greater PA levels were reported in members who attend the centre more often and for longer durations, as well as those who attend group exercise classes. However, it remains unclear whether CVD risk is reduced by this PA behaviour as effectively as structured exercise programmes recommended by the ACSM. The outcomes of this investigation will provide understanding of the impact of fitness centre PA behaviour to CVD risk factors, or potentially provide an alternative mode of reducing CVD risk aside from structured exercise programmes.

Updates to exercise recommendations occur over time as research investigates exercise options and new evidence is provided. These studies are necessary to challenge existing recommendations and to progress exercise prescription. Hence, studies comparing exercise prescription recommendations with other exercise options form part of this, particularly as new exercise options become more widely accessible, such as those within fitness centres.

The approach in this study was to utilise existing resources in leisure centres with inactive gym members (Della Vigna and Malmendier, 2006). This study aimed to assess the effectiveness of a 12-week, unsupervised, combined structured exercise programme, compared with free use of fitness centre facilities, or a non-exercising control group, for improving CVD risk factors in physically inactive fitness centre members. The question is raised whether the usual PA behaviours of fitness centre members, are sufficient at providing beneficial health outcomes to CVD risk factors compared with a structured exercise programme.

6.2. Methods

6.2.1. Study Design

This study was a randomised control pilot trial consisting of pre and post intervention testing. Baseline testing occurred prior to a 12-week intervention period. Consolidated Standards of Reporting Trials (CONSORT 2010) was considered for this study (appendix 9.8).

6.2.2. Participants

Participants were adults aged between 18-65 years, and current members of GO fit fitness centre, Madrid, which had not visited the centre for 60 days previous. Their absence was outlined using the online system at GO fit which tracks the attendance of members. Participants were to be free of disease, pregnancy and contraindications to exercise. Participants were expected to attend pre and post rounds of testing as well as the required number of visits to the centre (for the intervention groups, outlined in sections below) for inclusion in final analysis and reporting. Participants were excluded from final data analysis if they did not complete the required amount of sessions, and if they did not attend post-intervention testing for outcome measures.

Recruitment

One hundred members of a public fitness centre (GO fit Vallehermoso, Madrid) were randomly selected using a random numbers generator from an online registry of 127,514 members, from those whose profiles indicated non-attendance of the centre in the previous 60 days. This was automatically performed using an online platform and hence the total number of members absent from the centre in the previous 60 days was not known. Sample size was determined by the research team to be an appropriate target number of participants, in regard to screening procedures, resources and time allocation for the study. Members were contacted via telephone and asked to take part in the study. Prior to taking part in the study, each participant was given a full explanation of the study requirements, including a participant information sheet outlining the aims, objectives and basic methods behind the study in their native language which was Spanish (appendix 9.3). Seventy-four inactive adults (54 men, age: 43 $\pm$ 8 yr and 20 women, age: 42 $\pm$ 7 yr), were recruited from the facility's database and signed a written informed consent form and battery of questionnaires.

6.2.3. Baseline Screening Questionnaires

The IPAQ (Appendix 9.4) was administered at baseline to confirm they were inactive and not meeting the current PA guidelines of 150 minutes/week (600 MET.Mins.Wk^{-1}) of moderate to vigorous PA (WHO, 2010). The PAR-Q & YOU questionnaire (Appendix 9.5) ensured the participants were apparently healthy with no reasons contraindicating their participation in exercise.

6.2.4. Group Assignment

Using a random number generator, the participants were assigned to the following groups; combined structured exercise (COMB, n = 34), free gym use (FREE, n = 20) and control (CON, n = 20). This research project had full ethical approval of an independent ethics committee from Coventry University (Reference: P60826). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its' later amendments or comparable ethical standards. All participants were current members of the GO fit fitness centre and therefore had previously completed inductions to the centre.

6.2.5. Interventions

The 12-week exercise programme consisted of both COMB and FREE participants being instructed to complete three sessions per week. The COMB group were provided with a specific programme consisting of aerobic exercise, resistance training and flexibility exercises and were instructed to visit the facility and follow certain instructions (Table 23). The programme included modes, durations, loads, efforts and frequencies specific to each participant's ability. Intensity of resistance training was calculated using sub-maximal tests for estimation of 1-repetition maximum on resistance machines, and for aerobic exercise, was calculated from the Modified Balke test. Participants were able to monitor intensity using the capabilities of the aerobic exercise machines, which have built-in HR monitors that transmitted real-time HR data to the user. This ensured the participant kept their HR in the desired range from the age-predicted HRmax equation; 220 – age (ACSM, 2013). The FREE group had access to the same facilities as the COMB group, however, they were able to use any machines they wanted, and were instructed to attend the centre three times per week. The CON group were given no instructions but to continue their current behaviour. For the COMB group, training was spread over the course of 3 mesocycles (the divided periods of a macrocycle), each of 4 weeks long, whereby intensity increased and volume decreased. All participants were instructed to maintain usual dietary behaviour throughout the duration of the study.

Table 23: Schematic representation of the 12-weeks training period of the combined structured exercise programme. (COMB), structured in 3 periods of time (mesocycle) of 4 weeks.

VO_2max	**Mesocycle 1**	**Mesocycle 2**	**Mesocycle 3**
< 40ml/kg/min	60% max HR 20 min	65-70% max HR 30 min	75% max HR 30 min
> 40ml/kg/min	70% max HR 30 min	75% max HR 30 min	85% max HR 20 min
Resistance Exercises			
Leg Press / Squat Chest Press Lat-Pull / Row Hamstrings	**Week 1** 1 × 8-10 1-min rest **Week 2** 2 × 15 RM 2-min rest **Week 3 and 4** 4 × 10RM 2-min rest	**Weeks 5-8** 4 Sets 10 RM 2-min rest	**Weeks 9-12** 4 Sets 8 RM 2-min rest
Flexibility Exercises			
Lumbar Extension Shoulders & Scapular Joint Quadriceps Hamstrings Calf Muscles	3 Sets × 45secs	3 Sets × 45secs	2 Sets × 75secs

ml/kg/min: milliliters per kg per minute, HR: Heart Rate, Lat-Pull: Latissimus Dorsi Pull Down, max: Maximum, min: Minutes, Secs: Seconds, RM: number of repetition maximum in a set used.

6.2.6. Participant Tracking

Participants in the COMB and FREE groups were monitored by the researchers using a tracking system with electronic gym "keys" connected to the participants' user profile, online or through specific machines in the facility (Mywellness key, Technogym, Forly, Italy). These wireless keys were required for entry to the facility and for the COMB group, inserted into each piece of gym equipment, where the individual exercise programmes are stored.

6.2.7. Testing Procedures and Outcome Measures

Participants consented to the study in-person and immediately underwent the baseline testing procedure. Testing took place at a time selected by the participant and was noted so that the post-intervention testing took place at a similar time of the day. The following baseline measures were collected seven days prior, and seven days post-the 12-week intervention period, to examine CVD risk factors at baseline and after the intervention period. Invitations were sent via email and followed up with telephone if there was no response after five days. Participants were instructed to attend their testing sessions in a fasting state of at least 3 hours. Diet was not controlled in this study and participants were instructed to continue with their usual dietary habits. Testing included: (a) body composition measures (body fat percentage, body mass index [BMI], muscle mass [MM] and waist to hip ratio [W:H]), (b) Hemodynamic measures of systolic and diastolic blood pressure (SBP and DBP) and pulse rate (HR), (c) blood samples for CHOL, triglycerides (TRIG) and glucose (GLUC), (d) and cardiorespiratory fitness (VO_2max).

Questionnaires

The Spanish version of the following questionnaires were required to be completed by each participant, in the order listed: The International Physical Activity Questionnaire, (Appendix 9.4), (Hallal and Victora, 2004); Physical Activity Readiness Questionnaire "PARQ & YOU", (Appendix 9.5), (Thomas et al., 1992); ACSM Cardiovascular Disease Risk Stratification Screening Questionnaire, (Appendix 9.6), (ACSM, 2013). The ACSM Risk Stratification Questionnaire has previously been used to classify the level of risk, as well as the perceived risk of CVD the individuals have (Woringer et al., 2017). The PARQ & YOU questionnaire consists of seven yes-no questions with the aim of outlining any reasons why the participant might not be able to complete any PA such as previous maladies or high risk of injury or illness as a result of taking part in PA.

Body Composition

Body Composition was analysed using the InBody 7200, which has been shown to be a reliable tool for body composition assessments (Biospace Inc. Los Angeles, CA, USA). The InBody Body Composition Analysis machine uses segmental bioelectrical impedance analysis, calculating values for weight, body fat, body fat percentage, BMI, waist to hip ratio and muscle mass. The protocol used was the standardised procedure contained within the manual of the model (http://www.bodyanalyse.no/docs/720%20users%20manual.pdf). It required the height of each participant in order to complete the composition analysis.

Cardiorespiratory Fitness

Cardiorespiratory fitness was estimated using submaximal measures collected during the modified Balke test to predict VO_2max which is appropriate for older participants or those with elevated CVD risk or other conditions making maximal exercise challenging (Carnethon et al., 2003, Mann et al., 2016, Sidney et al., 1992). During the test HR was collected via a chest-worn Garmin HR monitor, (Garmin Europe Ltd., Southampton, United Kingdom), which was wirelessly connected to the COSMED FitMate Med VO_2max analyser (COSMED Srl, Rome, Italy), and a reusable oxygen mask. Exhaled gas and heart rate was used to predict VO^2max using the max HR equation: 220 – (age) and using the line-of-best-fit. Firstly, the treadmill started with 1-minute of familiarisation with the walking speed before the 2-minute warm-up phase starts. After this, the test phase commenced where the desired walking speed was set at either 3.4, 4.4 or 5.4 km/h and standardised as a constant walking speed. The participant walked for 1-minute at 0% gradient, after this the gradient of the treadmill was increased to 2% and then by 1% every minute thereafter. The participant was asked for their perceived rate of exertion (RPE) using the modified Borg scale (Williams, 2017) (1-10) every minute of the test, until they described an RPE 6 at which point the test was complete. A cool-down phase was initiated and VO_2max was predicted using the relationship between HR and VO_2 extrapolated to the age-predicted maximal HR. This test also dictated the intensity of the aerobic exercise undertaken by the COMB group whether the baseline measure was greater than or less than 40ml/kg/min.

Hemodynamic Measures

Resting blood pressure was measured using an oscillometer (Omron M3 HEM-7131-E, Omron Corporation, Kyoto, Japan) which also collected resting pulse rate (Kweku et al., 2017). Each participant was instructed to relax while sitting with both feet on the floor for 5 minutes prior to the recording. Three readings from the left arm were taken and an average of SBP and DBP and resting pulse rate recorded.

Blood Variables

Fasting blood samples were obtained using finger prick analysis and lancets, for cholesterol, triglycerides and glucose and analysed using the AccutrendPlus Blood analyser (Accutrend, Roche Diagnostics Ltd. 2010 Greenwood Village, CO, USA, distributed by Johnson & Johnson, S.A., Madrid) and corresponding Accutrend blood sample strips.

Resistance Exercise Intensity

Following the baseline testing of the outcome measures, 3 resistance exercises were used to inform the intensity of the structured exercise intervention; the latissimus-dorsi pull-down, Leg press and chest press. For the prediction of 1 repetition max, attempts were made to achieve between 3-10 repetitions at increasing resistance until failure was achieved, with adequate breaks between each attempt. Repetition max values were then calculated and predicted using the Brzycki equation [Figure 9] (Brzycki, 1993), so the participant did not have to perform any maximal effort attempts.

Figure 21: Brzycki equation. RM = Repetition Maximum, W = Weight, R = Number of Repetitions (Brzycki, 1993)

6.2.8. Data Storage and Protection

All results from the tests, and participant information, were stored on a laptop with a password that only the lead researchers had access to. Data was saved under anonymous codes where the participant cannot be identified, ensuring the data protection and security of participant's sensitive data.

6.2.9. Statistical Analysis

The statistical analysis was performed using JAMOVI statistical package (Version 09.05.12, Jamovi Project 2018, [Computer Program] retrieved from https://www.jamovi.org). The dependent variables were the changes (i.e. delta = post-minus pre-intervention) and the independent variable was the groups (COMB, FREE or CON). An analysis of covariance (ANCOVA) was used to examine main effects by 'group' for dependent variables with pre-intervention values used as covariates. For significant main effects, *post hoc* between group comparisons were made without corrections due to the small sample size and pilot trial nature of the study. Tests which were statistically significant were then reported with the Bonferroni correction, which has more power than the Tukey correction, when the number of comparisons is small. Estimated marginal means from ANCOVA were calculated with accompanying unadjusted 95% Confidence Intervals (CI). Statistical significance was set at $\alpha = 0.05$.

6.3. Results

6.3.1. Overview

In accordance with the target sample size, 100 participants were contacted via telephone, and 74 included at the initial enrolment session (adoption of 74%). 21 participants (COMB = 15, FREE = 6) completed the minimum number of required exercise sessions in the intervention groups (27 sessions or 75%), and 9 participants attended the post testing session from the CON group, resulting in a study retention rate of 40.5% (CONSORT diagram, figure 22). Therefore, data reported are of the 30 participants who successfully completed all aspects of the study. For cholesterol, twenty-three participants completed the tests and one participant was removed from the triglyceride data, due to faults in the data collection. Two participants obtained faults with the collection of their first testing procedures for glucose and therefore their data was not included for statistical analysis. Baseline characteristics for participants are shown in Table 24, there were no statistically significant differences between groups for any variables at baseline.

Figure 22: CONSORT flow diagram

Table 24: Baseline characteristics for all participants who completed the study

VARIABLE	COMB (*n* = 15)	FREE (*n* = 6)	CON (*n* = 9)
Age (yr)	46 ± 6	44 ± 6	46 ± 7
Sex (%M/F)	40/60	17/83	33/67
Height (m)	1.57 ± 0.44	1.64 ± 0.7	1.66 ± 0.7
Weight (kg)	80.4 ± 15.1	72.9 ± 9.9	76.3 ± 17.6
BF (%)	33.8 ± 11.2	37.9 ± 8.5	35 ± 8.1
BMI (kg·m^{-1})	28.4 ± 5.2	27.2 ± 3.2	27.2 ± 4.1
MM (kg)	29.1 ± 8.7	24.8 ± 6	27 ± 6.4
W:H	0.93 ± 0.07	0.93 ± 0.05	0.94 ± 0.08
SBP (mmHg)	121 ± 17	117 ± 10	126 ± 20
DBP (mmHg)	80 ± 9	79 ± 7	86 ± 13
PR (bpm)	73 ± 11	67 ± 11	80 ± 9†
CHOL (mg/dL)	225 ± 36	209 ± 31†	206 ± 14
TRIG (mg/dL)	162 ± 71	130 ± 55	133 ± 39
GLUC (mg/dL)	81 ± 24	81 ± 23	82 ± 20
VO^{2}max (ml/kg/min)	35.1± 10.8	29.6 ± 4.7	31.8 ± 3.4

BF%: body fat %; BMI: body mass index; MM: muscle mass; W:H: Waist:Hip ratio; SBP: systolic blood pressure; DBP: diastolic blood pressure; PR: resting pulse rate; CHOL: cholesterol; TRIG: triglycerides; GLUC: glucose. Data are means ± standard deviations.

6.3.2. Body Composition

ANCOVA revealed a significant main effect for change in MM ($F_{[2,26]} = 4.29$, $p = 0.024$). *Post hoc* comparisons revealed significant between-group differences for CON and COMB groups ($p = 0.018$; Bonferroni correction, $p = 0.055$) and FREE and COMB groups ($p = 0.031$; Bonferroni correction, $p = 0.094$). Estimated marginal means and 95% confidence intervals showed a significant within-group change in the COMB group for change in MM: +1.26kg (0.74 to 1.78kg), BMI: +0.03 (–0.34 to –0.39kg/m^2), Body Fat: –1.33 (–2.2 to –0.46kg), BF%: –1.7% (–2.49 to –0.93%) and W:H ratio: –0.025 (–0.039 to –0.012; figure 23). There were no significant within-group changes for any body composition outcomes for CON or FREE groups. ANCOVA did not reveal any significant between-group effects for change in weight ($F_{[2,26]} = 0.476$, $p = 0.627$), BMI ($F_{[2,26]} = 0.338$, $p = 0.716$), Body Fat ($F_{[2,26]} = 0.822$, $p = 0.451$), BF% ($F_{[2,26]} = 1.433$, $p = 0.257$) and W:H ratio ($F_{[2,26]} = 2.406$, $p = 0.110$).

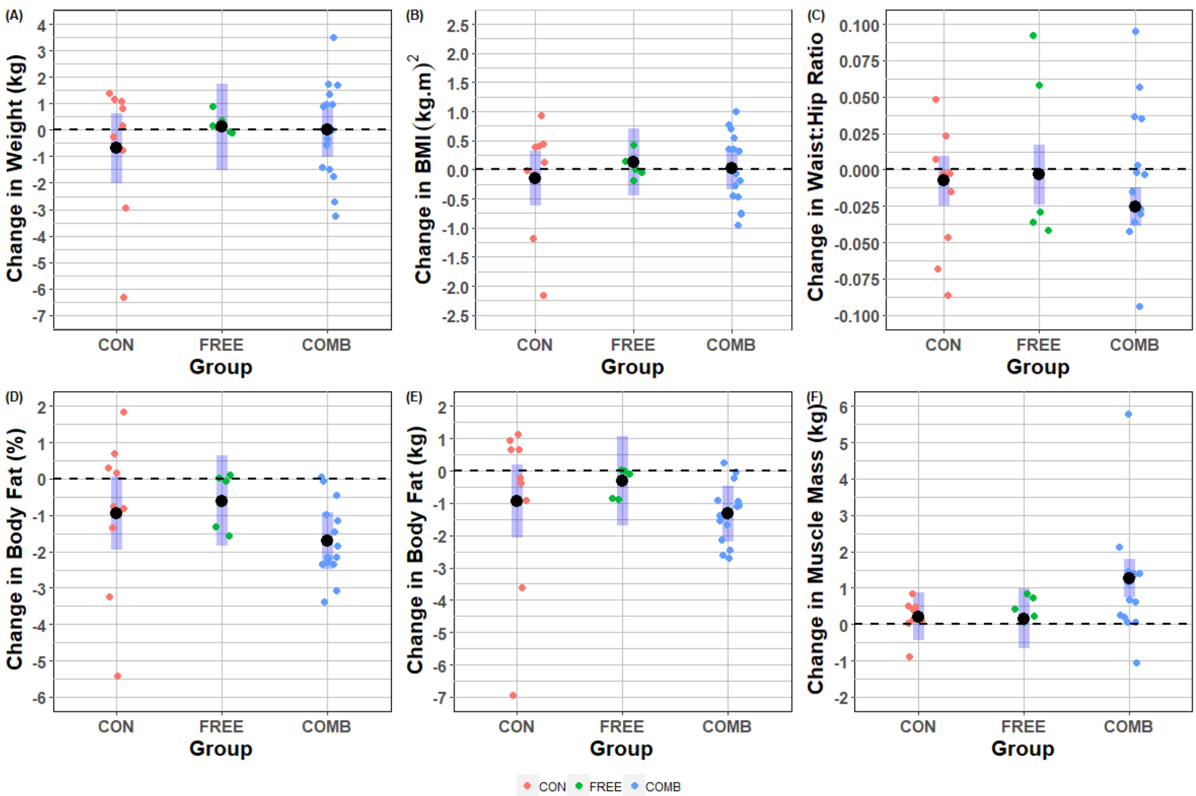

Figure 23: Change in body composition outcomes with 95% Confidence Intervals. Raw data points are presented.

6.3.3. Blood and Hemodynamic Outcomes

ANCOVA revealed a significant between-group effect for change in GLUC ($F_{[2,26]}$ = 4.97, *p* = 0.015). *Post hoc* comparisons revealed significant differences specifically between CON and FREE (*p* = 0.005; Bonferroni correction, *p* = 0.016) and CON and COMB groups (*p* = 0.032; Bonferroni correction, *p* = 0.096). ANCOVA did not reveal any significant between-group effects for change in CHOL ($F_{[2,19]}$ = 2.75, *p* = 0.089) or TRIG ($F_{[2,25]}$ = 0.007, *p* = 0.993; figure 24).

No significant between-group differences in change were found for SBP ($F_{[2,25]}$ = 1.92, *p* = 0.167), DBP ($F_{[2,25]}$ = 1.81, *p* = 0.184) or Pulse Rate ($F_{[2,16]}$ = 0.409, *p* = 0.671; figure 25).

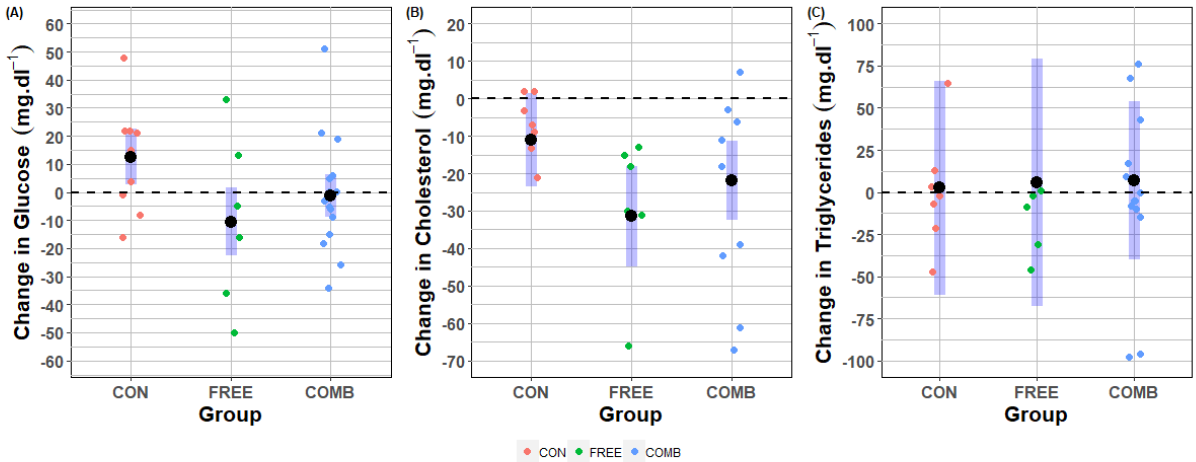

Figure 24: Change in blood outcomes (Left, Blood Glucose; Centre, Total Blood Cholesterol; RIght, Triglycerides, with 95% Confidence Intervals. Raw data points are presented.

6.3.4. Cardiorespiratory Fitness

ANCOVA did not reveal any significant between-group effects for change in predicted VO_2max ($F_{[2,26]}$ = 103, p = 0.903). No significant within-group differences were observed for any of the groups for changes in predicted VO_2max as shown by the estimated marginal means and confidence intervals for CON: +2.43mL·kg·min (–1.69 to 6.56mL·kg·min), FREE: 2.2mL·kg·min (–2.93 to 7.33mL·kg·min) and COMB: 1.33mL·kg·min (–1.91 to 4.57mL·kg·min; figure 25).

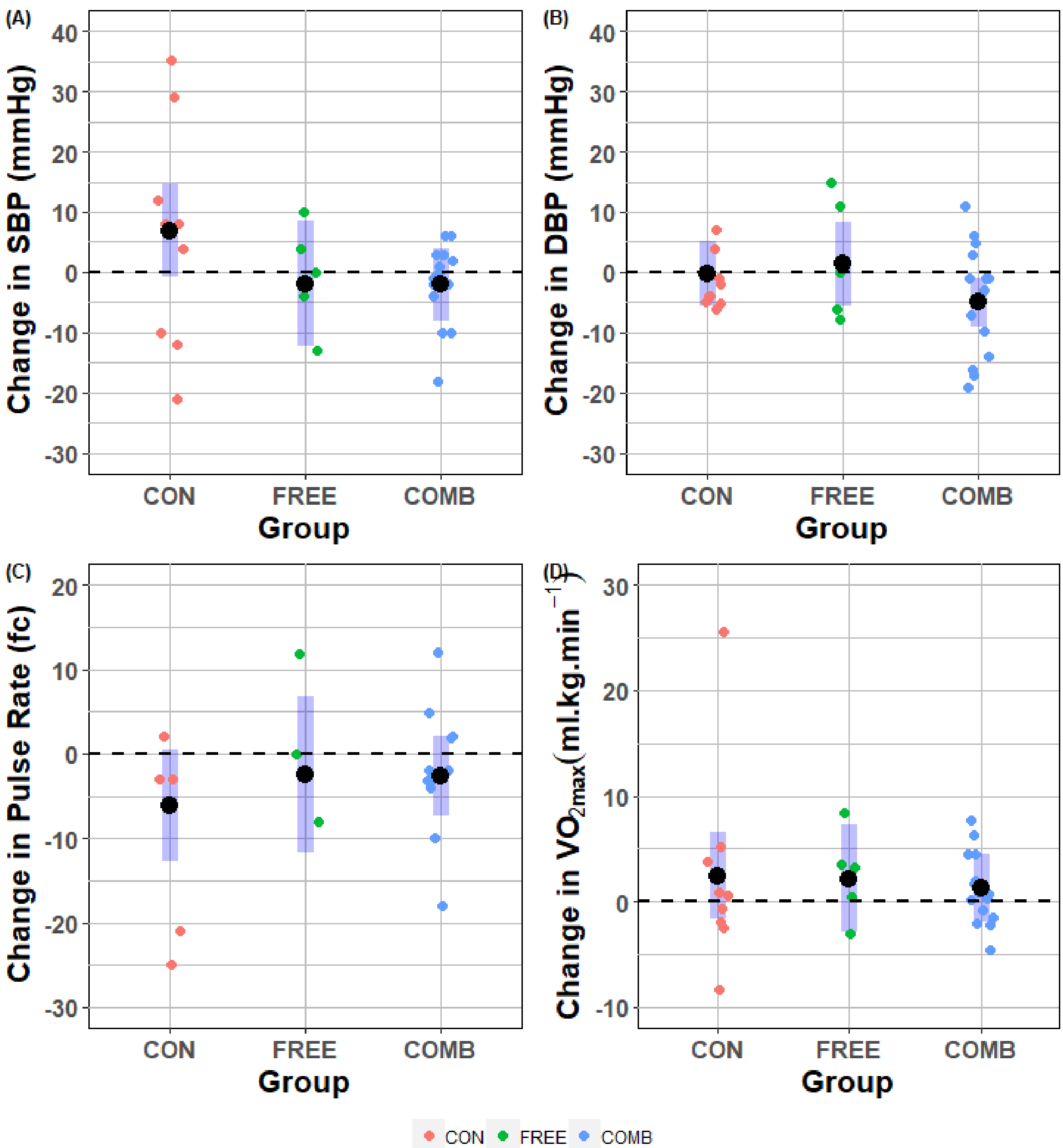

Figure 25: Change in hemodynamic outcomes and predicted VO_2max, with 95% Confidence Intervals. Raw data points are presented.

6.4. Discussion

6.4.1. Main Findings

Though exercise has been shown in numerous controlled studies to be effective in improving CVD risk factors, few studies have examined the effectiveness of interventions in real-world settings using fitness centre members. The previous chapters outlined fitness centre members are more active than the general population, though it is not understood whether their usual exercising behaviour improves CVD risk factors, compared with the exercise guidelines from the ACSM. Participants in the present pilot study were assigned to interventions in a public fitness centre following approaches commonly employed to implement exercise (i.e. free use of fitness centre facilities, or provision of a structured exercise programme). Results suggested that a structured exercise programme may be more effective for improving body composition compared to free access to fitness centre facilities, and a non-training control. Although, no significant between-group difference was reported (with *post hoc* corrections) in muscle mass between FREE and COMB. It is possible that because the training volume of the FREE group was not recorded, that the COMB group potentially performed a greater training volume which led to the improvement. It has been reported that even high-intensity, low volume exercise is insufficient to produce positive effects to body composition (Sultana et al., 2019). Whilst the FREE group were only instructed to attend the centre, what they performed at the centre was not under any direction or obligation and hence it is possible this was low volume and led to a lack of improvement. Further, combined exercise has been shown to be more effective than aerobic training alone at improving body composition (Marzolini et al., 2012). Hence, it is possible that if the participants in the FREE group performed mostly aerobic training, they may not have been able to produce an improvement in body composition, as reported by the COMB group. Self-selected exercise (FREE group) may be effective in improving blood glucose and cholesterol, but no other changes in CVD risk factors were observed. The clinical relevance of these results provides insight into the efficacy of exercise interventions. However, few participants achieved the minimum attendance required for the interventions, highlighting that effectiveness is less apparent with regards to adherence and retention. Further, the sample size and thus, statistical power, was small and may impact the changes detected in these variables. It could be suggested that a behavioural element included in the intervention would have benefitted the retention of participants in the study (Birnie et al., 2016, Dunn et al., 1997, Maddison et al., 2019). The sample contained 67% women, which may not be considered representative of the fitness centre demographic reported in chapters four and five of approximately 52% female population. Hence, this may have affected the results, as women are less likely to engage in strength and resistance training than men, and instead choose to engage in aerobic-based training (Bennie et al., 2018).

The World Health Organisation, and Shah and Braverman (2012), stipulate a body fat of 25% would classify males as overweight and 30% as obese (Okorodudu et al., 2010). The COMB group decreased body fat percentage by 1.4%, to 26% in a 12-week intervention, which may suggest that in a longer study, and greater training volume, the participants may be able to achieve clinically relevant levels below the overweight classification. The FREE group did not achieve a significant change in body fat nor any other body composition variable, suggesting that their training was insufficient to illicit improvements in body composition.

Diastolic blood pressure decreased in the COMB group from 79.9 at baseline to 75.6 mmHg, meaning participants had improved from very being close to stage 1 hypertension, (American Heart Association guidelines), to 4.4 mmHg below the clinical threshold. It could be suggested that these levels of DBP have less scope to improve, as it has been found previously that elevated blood pressure levels are more easily improved. Baseline values in the FREE group were classified as ‘optimal’ following the ESC guidelines, only the control group had non-optimal DBP levels at baseline. The clinical relevance of these results are that individuals with this level of diastolic blood pressure, will not be required to undergo a pharmaceutical blood pressure-lowering intervention, and most likely be prescribed lifestyle changes (Task Force for the Management of Arterial Hypertension of the European Society of Hypertension, 2007). Comparing these results with research from Van Roie et al. (2010) and Mann et al. (2016), which used similar interventions but with longer durations, reported significant decreases in DBP and mean arterial pressure by 5.5mmHg and 2.5%, respectively. A meta-analysis of resistance exercise training showed that DBP was also improved with in medium and long-term durations (7-23 weeks) by similar margins. They outlined that resistance training may have more impact in populations with a higher CVD risk profile. However, their review does not report the amount of resistance exercises prescribed in their studies. Being solely resistance training interventions, it may explain their results as they had a greater volume of resistance exercises compared with just four used in the present pilot study (Ashton et al., 2018).

Cholesterol was reduced in the FREE and COMB exercise groups to 180 and 198mg/dL, respectively, both from over 200mg/dL. Baseline levels would score ‘+1’ on the ACSM risk stratification, hence this is a significant improvement. Other studies report that a cholesterol lower than 200mg/dL can predict a longer estimated life expectancy, whereas other classifications suggest a cholesterol value of between 180 and 240mg/dL as the “middle” (Iribarren et al., 1995, Jeong et al., 2018, Stamler et al., 2000). Further, reductions in serum cholesterol by approximately 23mg/dL reduces incidence of ischemic heart disease by over half (Law et al., 1994). Serum cholesterol has been shown to reduce with body weight and can be achieved with exercise. Exercise also increases the stimulation of the enzyme lipoprotein lipase which is critical in transporting triglycerides and cholesterol from the blood to the liver (Kersten, 2014, Wang and Xu, 2017). Both exercise groups maintained or improved cholesterol levels when an increase was reported in the control group. This shows the clinical importance of findings from the exercise interventions including the FREE group for cholesterol. The positive reports from the FREE group support the PA behaviour of members who aren’t following specific guidelines or structured programmes, at reducing CVD risk and provide health benefits which reduce the burden to the individual and the economy. Whilst we are unsure on the specific PA behaviour being undertaken by the FREE group, it could be suggested that they undertook aerobic exercise or resistance training as both can produce beneficial effects to cholesterol, separately and in a combined intervention (Wang and Xu, 2017, Hsu et al., 2019, Mann et al., 2014).

No improvements were found for predicted VO_2max in any of the exercise groups. This may be due to the lack of sensitivity during the testing procedure which may rely too heavily on a predicted value for cardiorespiratory fitness. More sensitive, maximal tests could be deemed inappropriate for populations with high CVD risk and low athletic ability, but these methods have been implemented previously in sedentary men (Rogers et al., 1990). Furthermore, a maximal test would be less time-efficient as part of a larger health screening procedure and could possibly deter participation in the study and follow-up testing. Using submaximal tests and predictor algorithms for

VO_2max have shown to have high test-retest reliability, although there is a possibility of under- or over- estimation of cardiorespiratory fitness (Grant et al., 1999). It is possible that participants do not train with sufficient intensity when unsupervised, and therefore do not achieve beneficial changes to cardiorespiratory fitness. It could also be suggested that inconsistent leisure centre visits further contribute to the lack of a change in VO_2max (Duncan et al., 2005).

Body mass index, body fat, body fat percentage, waist:hip ratio, muscle mass and diastolic blood pressure were improved in the COMB group but not in the FREE group, though the between group differences were not statistically significant following the *post hoc* Bonferroni correction. This suggests that structured interventions as well as the controlled intensities of training programmes of these kinds (i.e. the intensity of effort, duration or mode of exercise specifically), were more effective than self-selected PA in the FREE group. Mann et al. (2018) have also reported in similar settings that body composition, particularly lean body mass changes, are greater from structured programmes. Based on previous literature outlined in earlier chapters, it could be suggested that overall training volume of the free-roam group was not sufficient enough to provide improvements in body composition outcomes (Maddison et al., 2019, Møller et al., 2018, Seward et al., 2019, Slentz et al., 2004, Teychenne et al., 2015, Tworoger et al., 2003). It has been reported by Rose and Parfitt (2012) that active individuals are more likely to self-select a higher exercise intensity than low active individuals. Hence, as this study used a population of inactive members, this may be the case for the FREE group when selecting their own PA.

While the use of exercise to improve CVD risk factors is not new (Beedie et al., 2015), limited data exist to show if exercising in a leisure centre produces the same meaningful CVD risk factor reduction observed in laboratory-based or controlled, supervised studies (Pan et al., 2018, Vieira et al., 2018). This pilot study suggested that exercise performed in a leisure centre may be efficacious; improving selected CVD risk factors, without a supervised exercise intervention. Hence, fitness centre members may be receiving some beneficial health outcomes, without a structured exercise programme. These findings should now be examined in a full trial with adequate sample size for statistical power, to detect clinically meaningful differences between groups. It would also be insightful, to examine the specific exercise being undertaken within the free-roam group, such as group exercise class attendance which was shown to be a predictor of PA engagement in the previous chapter.

Human exercise laboratory-based studies do not usually translate well to real-world environments (Beedie et al., 2014). This may be caused by factors associated with engagement and motivation, which typically drop following completion of a supervised, laboratory-based intervention (Beedie et al., 2015). Attendance and retention to this study were expected to be low, with typical retention rates of 25-40% in studies with similar methods and setting (Beedie et al., 2015, Mann et al., 2016). No participant in the present study completed 100% of the prescribed sessions, and though reasons for compliance weren't recorded, motivation, lack of enjoyment and mental well-being are possible factors contributing to drop-out (Picorelli et al., 2014). Other research offers insight to similar adherence and retention rates with some suggesting that age and gender can predict retention rates and likeliness of completion. This is supported by the previous experimental chapters predicting PA behaviour, as well as cost and location of centres (Isaacs et al., 2007, Martín-Borràs et al., 2018). The COMB group retained the most participants. Participant retention may correspond with the habit formation hypothesis within the organismic theory of self-determination behavioural psychology, whereby the consistency of the structured programme allowed for the habit to be developed more easily than those in the free group, who may have exercised with less structure and consistency (Kaushal and Rhodes, 2015). Hence, this all points towards a behaviour-focused element within the intervention, such as counselling sessions alongside the exercise programme to improve or maintain PA behaviour.

The use of the electronic keys and the liaison with the interactive programme used by those in the COMB group, provided support in a similar way that supervision typically can. Formal supervision has been shown to improve the effectiveness of programmes at reducing CVD risk factors, and improve retention of participants. Developing the interactive elements of this study like the "key" and the gym machines which visualise progress, could potentially enhance the retention, adherence and engagement of individuals undertaking exercise programmes. External motivation from a supervisor and the challenging of participants increases motivation, and enhances adherence to CVD risk reduction interventions (Michie et al., 2011, Olander et al., 2013, Martín-Borràs et al., 2018, Fennell et al., 2016).

Despite the findings of previous chapters in this thesis showing that public fitness centres have better PA behaviour than the general population. The present study may suggest that in order to improve the CVD risk profile more widely, a structured exercise programme is more effective at improving CVD risk factors than self-selected PA behaviour. This is important to clinicians prescribing exercise programmes to patients with differing risk profiles, which has been shown to have significant inter-clinician variance (Hansen et al., 2018). However, due to the nature of the study (i.e. small sample size) and the purpose of this study as a pilot trial, drawing conclusions from the results regarding the effectiveness of the interventions is challenging. The findings from this pilot trial can now be tested in a larger scale intervention, knowing that these methods can be administered and followed appropriately, and long-term effects can be accurately studied. In the pursuit of a more in depth comparison, methods should be developed to allow an insight into the specific exercise options the FREE group are engaging with, as this could provide a rationale for options such as group exercise classes, which was described in chapter five.

6.5. Limitations

Some limitations to this study should be noted. First, is that 40.5% of participants completed the study. Despite this being low and the small sample size included for final analysis, it is within the typical rates for this kind of study (Gondim et al., 2015, Mann et al., 2016), and is consistent with the average number of fitness centre visits (MacIntosh and Law, 2015). Further, the small sample size can affect statistical power and hence the findings should consider this. A second limitation is that dietary habits were not monitored in this study, which have been shown to affect CVD risk factors. However, because of the real-world nature of the study, the results would be more applicable if diet were not controlled, as the study would better replicate a public health intervention. It was not possible at the time of the study to monitor the intensity or mode of the exercise completed by the FREE group. It may have been useful to compare with the COMB group, although this would require greater resources to track this number of individuals and monitor their engagement. It would also require greater involvement from these participants as they are required to use the facilities and equipment in ways to ensure their activity is recorded. Physical activity behaviour was not controlled outside of the fitness centre which may have affected the positive effects on CVD risk factors in this study. Although, it has been previously reported that increased health responsibility in gym members was associated with fitness centre membership rather than an increase in participation of PA (Ready et al., 2005).

There is also a limitation of volunteer-bias for those members who agree to participate in exercise studies, who are likely to have a greater propensity to engage in PA. Conversely, there is a possibility of bias in the direction of inactive members having larger scope for improving CVD risk factors due to elevated baselines levels, and hence may affect results in this way. Finally, reasons for drop-out were not recorded. A drop-out questionnaire would have been useful in understanding the reasons for non-completion of the study and adherence and retention to exercise programmes of this kind.

6.6. Conclusion

This pilot study examined the effects of two real world interventions (an unsupervised structured exercise programme, and free access to leisure facilities) upon CVD risk factors in a real-world environment in an inactive population of fitness centre members. Unsupervised structured exercise programmes of aerobic exercise, resistance training and flexibility exercises, may be effective in reducing CVD risk status by significantly improving risk factors such as body composition, total cholesterol and blood glucose. Free access to leisure facilities and self-selected PA may also be effective for improving total cholesterol and blood glucose, though not body composition. This suggests that fitness centre members are achieving beneficial health outcomes as a result of their PA behaviour at fitness centres, although these may be further enhanced with a structured programme. This pilot study indicates that it may be possible to translate results relating to efficacy of exercise interventions to effectiveness in real-world settings. Retention to exercise interventions like these remain low, however consistent with retention of fitness centre members and other studies. Larger trials in real-world settings examining effectiveness and implementation of similar interventions are required for validation of these findings.

Chapter 7. General Discussion

7.1. Main Findings

This chapter provides an overview of the findings from the previous experimental chapters and the main discussion points that have arisen from this research project. The focus of this thesis was to investigate and understand the PA behaviour of fitness centre members. Firstly, the literature was systematically reviewed, examining exercise programmes in community based settings. Secondly, reported PA levels from fitness centre members were compared with the general population of Europe and Spain. Thirdly, predictors of PA behaviour in fitness centre members were investigated. Finally, in an RCT, the effectiveness of self-selected exercise behaviours at improving CVD risk factors in fitness centre members, was compared with recommended structured exercise guidelines.

The studies in the current thesis have furthered the knowledge as follows:

- Outlined a paucity of research in community-based settings assessing PA on CVD risk factors.
- Interventions with a behaviour-change element or supervision retain participants better than studies without.
- Training volume affects the improvement of multiple risk factors, more than isolated training intensity or training duration.
- Fitness centre members perform greater PA than Europe and Spain and have a greater prevalence of highly active members (>3000MET.Min.Wk^{-1}). Outlined a population of physically inactive fitness centre members (9% of members).
- Predictors of PA behaviour were associated with socioeconomic variables but income was only a predictor for membership duration. Increased fitness centre visits, duration and group exercise class attendance predicted increased PA behaviour.
- Structured combined exercise was more effective at improving multiple risk factors but usual, self-selected PA behaviour may still improve cholesterol levels in inactive fitness centre members.

7.1.1. Current public health evidence on Physical Activity

This thesis provides evidence that fitness centre members are highly active, and may experience the health benefits accompanying a more physically active lifestyle. However, the ACSM recommended guidelines may be the most effective programme for improving CVD risk factors. It further supports the premise that fitness centres should be the “hub” for PA, as members reported higher PA behaviour than the general population, which suggests they potentially have a lower risk of CVD. However, PA is a complex behaviour and hence this thesis also suggests that socioeconomic factors as well as demographic characteristics should be considered when prescribing PA, particularly a behaviour-change element. Other fitness centre-related considerations can be made for prescribing PA to inactive members, which this project also outlined. For example, group exercise class attendance was reported as a predictor for greater PA behaviour. Further investigations similar to the present one are necessary within populations throughout Europe to substantiate this evidence in other populations.

The systematic review in this study found a lack of literature set in community or public-based settings, and hence a need for more studies to increase ecological validity. Furthermore, the quality of reporting should be improved to include standardised methodology, sufficient for replicating and comparing results between studies, particularly for adherence and retention results. Finally, generally healthy and at-risk participants should feature more often in the literature, to indicate an overall improvement to the CVD risk or health profile, rather than a focus on singular risk factors such as diabetics or post-cardiac event individuals.

For the collection of data on PA behaviour, this thesis accessed and analysed secondary data, collected using self-assessment PA questionnaires within large surveys. Some limitations must be considered in context with the findings of this thesis. Firstly, these reports rely on the voluntary participation of individuals and in the case of this project, GO fit members. Hence, this sample may not be representative of the fitness centre population as it could be that the most active members decide to take part in these surveys, and therefore the sample may be affected by non-response or volunteer/self-selection bias (Harvey et al., 2018, Van Loon et al., 2003). Further, 127,514 survey invitations were sent out to members, and 12,371 were returned by

GO fit members with some form of completion; under 10%. Hence, this could be evidence of non-response bias, though tests were not performed to asses these biases, they are acknowledged throughout.

Reports which use self-report data collection methods are able to provide information on a large scale, helping to guide and inform policy, and are inexpensive and relatively simple to conduct and produce (Safdar et al., 2016). Reports from various countries and in many studies should aim for uniformity in the administration of reports including the survey questions such as the IPAQ, as this would benefit cross-population comparisons. This thesis found differences between GO fit members and Europe in regards to PA behaviour, however, there were differences between IPAQ formats used in the surveys. Additionally, the main focus of the surveys administered were not to investigate PA behaviour, and so there is a possibility all PA behaviour was not captured by the questionnaires.

7.1.2. The role of fitness centres in increasing PA levels

Chapters four and five in this thesis placed the members of public fitness centres in the context of the general population by comparing PA behaviour and socio-demographic characteristics and investigated the predictors of PA behaviour. Fitness centre members were more active than the respective averages of the general populations across Europe (3099.78 ± 2204.69 MET.Mins.Wk^{-1} vs 2355.61 ± 2331.19 MET.Mins.Wk^{-1}) and defined as "highly active" by classification of PA levels from the IPAQ scoring system (IPAQ Research Committee, 2005), and predictors were observed to be socioeconomic and related to engagement with the fitness centre. Whilst this may suggest the impact that fitness centre membership can have on the PA of individuals, it is possible that fitness centres attract already active individuals. Hence, pre-membership activity levels would need to be compared with current PA behaviour to fully understand this. However, the surveys used in these chapters did not primarily aim to investigate this. Hence, capturing further specific PA behaviour data would improve this investigation and lead to more applicable findings.

This thesis reported fitness centre members having sedentary behaviours similar to the general population (Sitting time: Between 5 hours 31 mins and 8 hours 30 mins = 32.5%), despite possibly being classed as highly active. Suggestions from Ekelund et al. (2020) that high levels of PA potentially offset the negative impacts of sedentary behaviour, may apply to this population of GO fit members. However, the beneficial effects of PA may not be as great as the individuals are expecting, and they may still suffer from the negative health effects of sedentary behaviour, such as increased CVD risk (Grøntved and Hu, 2011, Wilmot et al., 2012). This finding may help in raising awareness to those who are active yet still sedentary, accommodating both definitions in their lifestyle, that their PA levels may need to increase for an impact that will overcome the negative associations with sedentariness.

The use of surveys are not without limitations which have been outlined above. With an increasing number of fitness centres and easier access, it might be beneficial to produce a standardised survey across the industry (Herman et al., 2019). A standardised format would provide more information, on an even larger scale, on PA as well as motives for PA engagement, socioeconomic factors and others, and hence provide insight into less active individuals as well as those utilising public fitness centres. Insight into less active populations would allow for more targeted interventions and strategy at improving PA behaviour, whether it be accessibility and barriers to exercise options, or education for health awareness. A standardised procedure would suggest the consistent use of the IPAQ with regards to long or short form, telephone calls or in-person formats, “typical week” or “the previous seven days”, and categorical responses or open-ended response options, so that data can be collated, cleaned and analysed with more consistency. This point is outlined by the difference in the surveys administered to the fitness centre members, and the Eurobarometer to the general population.

7.1.3. Predictors of greater PA behaviour and fitness centre engagement

There is a paucity of research predicting increased PA behaviour in fitness centre members. Previous research has investigated the predictors of abandonment of fitness centre membership (Clavel San Emeterio et al., 2019), though most focus on PA predictors in the literature is given to school children and adolescents, rather than adults (Pardo et al., 2016, Cocca et al., 2017). In previous studies, socioeconomic factors have been reported to predict PA levels, which was also the case in this study. However, this study also outlined other predictors such as; number of visits, visit duration, motive and exercise class attendance. Whilst the study may challenge the impact of income as a predictor of PA, other socioeconomic variables were present, supporting the hypothesis that individuals of higher socioeconomic status are more active (Stalsberg and Pedersen, 2018). However, the results consisting of fitness centre engagement have not previously been widely studied. Whilst this may be a novel contribution to the literature, further studies within fitness centre members and predictors is recommended, informing fitness centres on how to ensure long-term membership and sustained adherence to an active lifestyle.

The findings of this study can be utilised by fitness centres and other PA initiatives, such as providing more options which are likely to enhance engagement such as group exercise classes which are exclusive to females, increased opening times for longer visit durations or increased number of visits, and making other options available which are likely to contribute to the time spent within the centre which is also shown to be a predictor of increased PA levels. With regards to motives, providing PA behaviour change support with consideration of self-determination theory may also positively influence PA behaviour within fitness centre members.

This thesis reports a difference in activity levels between males and females, as well as sex being a predictor of many engagement behaviours with the fitness centre. Throughout, males predicted greater activity levels except for the case of group exercise classes, reporting females having greater attendance. Over the past decade, female-specific exercise options have increased, with fitness centres now providing female-only areas and activities. However, this study suggests this must continue so that the PA behaviour-gap between sexes can be improved. Furthermore, future investigation into the factors associated with sex-differences in PA behaviour within fitness centre members, as there are many facets which extend beyond exercise in to societal reasons (Guthold et al., 2020, Telford et al., 2016).

7.1.4. Structured exercise compared with free usage of fitness centre facilities

Fitness centres provide facilities for a wide range of PA options available for self-selection. With the studies in this thesis outlining the beneficial effects of fitness centre membership on PA behaviours, the impact of the exercise undertaken with regards to CVD risk factors, was compared with recommended structured exercise. The structured exercise group was shown to provide more CVD risk factor improvement such as, improved muscle mass, body fat, waist to hip ratio and glucose. Although, the “free roam” self-selected exercise group also reported improvements in blood glucose and cholesterol. Hence, chapter seven provides support to the findings of the previous two chapters, outlining fitness centre members have an improved CVD risk profile as a result of their PA behaviour, compared with the general population. However, the final study requires replication in larger samples to see the significance of these changes. A larger study would provide further rationale for fitness centre membership, as well as the role fitness centres have in the domain of public health.

As the results from the pilot study and indeed the preceding chapters suggest a positive outcome from fitness centre members’ PA behaviour, what is achieved within the centre, and what PA is being undertaken outside of the centre should be explored. Further data on PA behaviour away from fitness centres would allow for a more detailed insight into the PA behaviour of fitness centre members, and potentially the beneficial health outcomes achieved specifically from within the centre.

With regards to the retention and long-term engagement of individuals to PA behaviours, the structured exercise group was able to retain the most participants come the end of the intervention period. A long-term trial of this study would perhaps provide more insight into each interventions’ ability to retain individuals, and whilst the free roam group was able to provide beneficial health outcomes, it may not be as successful in retaining individuals. The studies within this thesis suggests that consideration of a behaviour change element included in exercise programmes or as an available option within fitness centres, will help sustain long-term engagement in PA behaviour.

The studies in this thesis demonstrate methods which were successful in monitoring and evaluating PA behaviour and an exercise intervention in a real-world setting. Hence, this can now be used in other, larger investigations, and proposes the use of technology in the form of online platforms and electronic “keys’, in aiding the recording and collection of participants’ PA, for real-time and objectively measured PA behaviour.

7.2. Recommendations

The information contained within this thesis outlines the role of fitness centres in the pursuit of improving public health using PA. The review of literature analyses current public health situations with reference to CVD, analyses exercise studies as well as those set in public or community based settings, and discusses the issues with research studies in this area of literature. The experimental chapters report a large difference between the PA behaviour of fitness centre members and the general population, and the predictors of this population achieving greater PA engagement. It is suggested that various improvements can be made to the reporting of public health data and the methods currently used in investigations, which would provide clearer insight into the behaviour and demographic characteristics of fitness centre members and the general population. The following sections outline key recommendations covering the issues discussed from each of the previous chapters and how these might be implemented for future research and practice.

7.2.1. Key Recommendations

Literature and reporting

Quality of reports

Firstly, the quality of reports must be improved, for the review and analysis of effective interventions in public health. The guidelines for reporting from the EQUATOR network should be closely followed by the studies in the literature investigating PA behaviour (https://www.equator-network.org, 2022). Specifically, conforming to the Consensus on Exercise Reporting (CERT), would provide robust and detailed reporting of the methodology of exercise interventions being undertaken in exercise trials, and how their studies are carried out (Slade *et al*., 2016). High quality and robust reporting is not only the responsibility of researchers, but also of the peer-review process. Distinctions must be made regarding supervision of exercise programmes, as well as adherence and attendance, and what is required from participants in studies for their data to be analysed for the final inclusion for results. It would be beneficial for the quality of research if drop-out questionnaires were administered to allow for the understanding of reasons for drop-out, which can then be considered in the design of exercise interventions in the future. Further distinctions and acknowledgements must be made regarding the “effectiveness” of interventions and drawing conclusions from laboratory-based interventions. Finally, the interpretation of results from laboratory-based studies which are considered successful or “effective” should acknowledge the extent to which they succeed in what they aim to do. For example, improving specific risk factors to reduce overall risk, the continuation of laboratory-based research as a public-based initiative, and the significant results potentially not translating well into other populations.

Setting and sample

For the progress of public health initiatives aimed at improving health outcomes through PA interventions, the literature must aim to investigate *true* effectiveness, by placing further consideration on the setting and environment of studies. Whilst lab-based investigations are important, translating these into public environments can be challenging and would not necessarily be effective. This thesis showed that public or community-based fitness centres offer a location which is more suitable for physical activity interventions and is a likely setting for exercise in the public, rather than a clinical or human-exercise laboratory. Further, studies should investigate the PA behaviour of fitness centre members compared with the general populations of other countries and other fitness centres, to provide further insight into the predictors of PA and sustained engagement with the fitness centre. Existing fitness centre members are not as financially inclined to achieve positive results, as opposed to non-members being introduced to the centre for the purpose of a study, which potentially affects the adherence and hence the results. There is a limitation of selection bias with the participants throughout the studies in this thesis. Firstly, those members responding to the survey, and particularly the IPAQ, are likely to perform greater PA than non-responders (Harvey et al., 2018). Secondly, the participants in the pilot trial could also experience selection bias as members may have a greater propensity to become more physically active and achieve the most from their membership, and hence be more motivated than the general population. Although, there may be a weaker bias towards having more health issues, as these members are physically inactive (Harris et al., 2008). Future studies should also recognise the interference of bias within the populations and samples selected. Further, the socio-demographic characteristics of members are likely to possess bias, as these members can all afford a similar priced membership, within cities across Spain, which might not be representative of the general population of fitness centre members. However, the populations used in these studies are broader than studies using facilities on University campuses, which are likely to be over-populated with typically student-aged individuals (aged 19-24 years). Therefore, findings become not only more appropriate with regards to location, but also more applicable with the breadth and diversity of the population.

Conducting this research in this setting has allowed for a valuable insight into getting the most from this population in this setting. Hence, it is advised the following key tips for performing and undertaking research in similar settings and samples:

- Cross-sector partnerships. It is imperative that the approach to understanding public fitness centre members for the benefit of the health of the general population that multiple sectors must work together. That being; public sector organisations, private sector health and fitness providers and the academic organisations working together. Each bring a unique contribution and hence it is recommended that more partnerships are formed similar to those included in the current thesis between Coventry University, UK Active and Europe Active and Ingesport Health & Spa (GO Fit).
- Gain a personal relationship with as many participants as possible, which will help build trust and make them feel less like a participant in a research project at one moment in time.
- Demonstrate testing protocols which may appear daunting or off-putting to make the participants feel at ease, which will likely make them return for future testing appointments, such as VO_2max testing, and blood analyses in the current project, this was a key part of retaining participants in chapter 6 for post-intervention testing.
- Be flexible and accommodating – whilst this may add to the time and effort of the research team it will go a long way in retaining participants if they can witness you making time for them and offering them a favour. It may also contribute to the likeliness that those participants will be more willing to engage with other research projects in the future.
- The literature review showed that consistent, quality reporting is required and hence it is recommended that a clear and robust methods are reported in future studies. In particular, defining an inclusion criteria which outlines the participants obligations such as compliance, adherence, completion and

attendance. As well as detailed descriptions of interventions including the setting and supervision status. Researchers should aim to comply with a criteria for reporting which is uniform across all studies in the area which would improve the quality of reporting and make reviews and comparisons easier.

Consistency and uniformity in reporting PA

The literature review and studies within this thesis found that across the literature and reports from governing bodies and other organisations, exists a broad scale of reporting techniques and tools to gather public health information. Inconsistent and diverse reporting makes cross-examination, and often interpretation of results, difficult. For example, the IPAQ is administered in many studies, however, different iterations are used. For overall PA, the IPAQ questionnaires have the options of answering with regards to a “typical week” or “the previous seven days”, as well as an option for open-ended answers or clustered answers, “0-15 mins” for example. There is also the undertaking of this questionnaire, with some being supervised giving the respondents or researchers the opportunity to ask questions, or an entirely self-administered version. In cases where the questionnaire is sent as an electronic version, participants are left to interpret questions on their own, and to classify the intensity of their PA behaviour. Furthermore, as this thesis has outlined the importance of motives for PA behaviour, a valid and reliable tool assessing motivation should be consistently used in the literature to understand this further, in multiple populations and studies, which can then be cross-examined. It is possible that the motive question used in the studies in the current thesis may not have been as useful as other tools, though this is only found when trying to cross-examine results with other studies. It is also much shorter than the EMI-2 which would have meant a greater time commitment from participants to a longer questionnaire, which may have affected response rate.

Time sensitivity of reports

The other issue within this area is with the time frame of undertaking and producing results. In most cases, reports reflect data collected at least 12 months prior to the publishing of the information. Consequently, if we consider the resultant design of initiatives based on the reports, we are behind the current data and PA behaviour by approximately one year, potentially longer. Hence, it is beneficial for studies to utilise existing frameworks which will aid data collection such as pre-existing surveys which is evidenced in chapters four and five of this thesis. Collaborations between organisations such as those between UK Active, Spain Active and EuropeActive will help with the implementation of consistent surveys being administered. Consistency will also improve cross-examination and the time-efficiency of producing reports which inform public health and in particular CVD risk and PA.

Future Reporting

Results from this thesis lead to a recommendation that a uniform process of reporting for surveys is considered and applied by researchers within the literature as well as by organisations administering reports, alongside directly measured PA to support self-report data. With this consistency, better comparisons and cross-examination of populations would be easier as well as analysis of results between studies. It may also be possible to administer surveys and produce reports more regularly, which would decrease the time-frame and bridge the gap between information on reported behaviour, and the design of initiatives based on the behaviour. The utilisation of existing databases and populations will also be pivotal when surveying large populations, quickly and easily, which would further suggest the use of fitness centres and their membership pools. It is advised that this be undertaken by the UK Active organisation in partnership with their international counterparts; Europe Active and Fundación España Activa (Spain Active), and that this partnership is transmitted to the community-based fitness centres to form a large and broad, consistent system, enabling the report-based literature to be more efficient and robust.

Exercise Interventions

It is known from the literature that many types of exercise interventions will produce positive effects to isolated CVD risk factors. However, it is less well known whether the structured exercise interventions are more beneficial than peoples' usual exercising behaviour. This is particularly true for fitness centre members, and whether any additional benefits may be obtained from such programme, opposed to their usual self-selected PA. Whilst the studies in this thesis showed that on average, fitness centre members achieve more PA, likely resulting in a lower risk of CVD, structured exercise appeared to provide more beneficial outcomes by positively altering multiple risk factors, and retained the most participants. Greater PA in fitness centre members was predicted by socio-economic variables as well as greater attendance at the fitness centre and group exercise classes, and that "free roam" exercise may produce significant improvements to some CVD risk factors. Therefore, investigations should look at ways of ensuring people meet PA guidelines or attend fitness centres. The work in this thesis supports the inclusion of a behavioural intervention which considers the motivation and personal factors of individuals, including PA behaviour counselling within the centre, more supervisory staff, more accessible opening-times, more group exercise classes and female-only exercise options are also factors which may improve PA behaviour (Avery et al., 2012, Kahn et al., 2002, Morris et al., 2014). Further research is required in larger samples, possibly across multiple fitness centres to further understand the effectiveness of free roam exercise options, compared with ACSM intervention guidelines, for sustained, long-term exercise behaviour, and the improvement of CVD risk. Tracking PA behaviour of free roam groups in future studies will provide insight as to what type of exercise is undertaken, and whether their behaviour is similar to that reported in this thesis. Further PA behaviour data collection should be implemented in the succeeding, larger study in continuation of the pilot trial in chapter seven.

7.2.1. Impact of COVID-19 and implications to PA Behaviour

It is acknowledged that the research contained within this thesis took place prior to, and during the COVID-19 pandemic, the entire data collection took place before national lockdowns, quarantine and prolonged periods of mandatory home confinement. Hence, this research is a reflection of PA behaviour before the pandemic and that PA behaviour was not in any way affected by the COVID-19 pandemic.

For large periods of time the COVID-19 pandemic resulted in the full closure of public fitness centres and other facilities for PA. Hence, home confinement and national lockdowns are likely to have impacted the PA behaviour of the general population which may implicate the recommendations of this research project, and may implicate the results of the research questions postulated in the studies contained within this thesis. A report from Spain has indicated that the PA behaviour of the population decreased during the COVID-19 lockdown by approximately 20%, and a decrease in people meeting the PA guidelines from 60.6% to 48.9% (Lopez-Bueno et al., 2020). Another report provided evidence that alongside the reduction in PA, sedentary time also increased during the home confinement period, by approximately 2 hours per day (Trabelsi et al., 2021). The decrease in PA behaviour further highlights the need to explore way of improving PA behaviour by increasing accessibility and creating PA options, which include public fitness centres to the general population.

Despite a decrease in PA behaviour, other research has indicated that the COVID-19 lockdown did improve awareness of PA promotion and hence could help achieve greater PA behaviour post-lockdown (Gelius et al., 2021). Further, an increased awareness around online exercise classes occurred during lockdowns in Europe as these were promoted by WHO, as a COVID-safe, time-flexible and often free alternative, whilst public fitness centres were forced to close (Füzéki et al., 2021). For instance, it was reported that almost 83% of users of online exercise classes in the U.K. were non-users pre-lockdown and that watching online exercise classes during lockdown was a predictor of meeting current PA guidelines (Martin et al., 2021, Symons et al., 2021). Although, it was reported that regular usage of online exercise classes was quite limited, and therefore do not replace in-person offerings (Füzéki et al., 2022). It was recommended that efforts to keep public fitness centres open and accessible should be prioritised. Hence, the role of fitness centres in the context of COVID-19 and a post-COVID Europe remains important in improving PA behaviour in Europe, as reported in this thesis.

Considering the relevance of the findings of this thesis post-COVID-19, it is suggested that the recommendations still have applicability and could possibly be more strongly recommended since the decrease in PA behaviour, and increase in health-awareness. Increasing accessibility to alternate exercise options, such as online/virtual exercise classes, are relevant post-covid as people aim to improve their PA behaviour but may still have reservations around attending busy gyms or group-exercise classes in-person. Improved and increased PA surveillance is strongly recommended post-covid to assess the activity level of the population which can change quickly and drastically, especially to account for the progress made or lost, against the aims of the Global Action Plan. For the time-sensitivity of achieving global targets for PA behaviour, the recommendations of cross-collaboration between industries remains paramount.

7.3. Conclusions and Future Research

For the reduction of deaths due to CVD, PA levels must be improved, particularly in Spain which report low levels of PA. Key findings of this thesis support the notion that fitness centres have an important role in the domain of public health, acting as a hub for PA and active lifestyles. This thesis shows that fitness centre members are more active than the general populations of Europe, with socioeconomic factors continuing to be a predictor of PA levels as previous research has demonstrated, as well as engagement and group exercise class predicting increased PA behaviour. The activity undertaken within fitness centres provide beneficial health outcomes with regards to CVD risk, though perhaps not as beneficial as structured exercise programmes recommended by the ACSM. Research within this area relies heavily on lab-based research, and hence the work contained in this thesis draws attention to that and provides methods which can be effectively used in real-world interventions, providing the results with greater ecological validity, by better replicating usual exercising environments. However, further research implementing these methods in community-based settings is required on a larger scale and in more diverse populations.

For the global community to meet the targets of reducing physical inactivity and the burden on the economy from treating preventable CVD caused by lifestyle factors, research must first be able to accurately assess the global situation. Hence, reports and surveys should be utilised in large populations, which has been outlined in this project. This thesis observed that fitness centre-specific exercise options predict PA behaviour and therefore future studies should also aim to understand the impact of alternative or new PA and exercise options, such as group exercise classes. Further, understanding the motivations which drive PA behaviour, which is reported in this thesis to predict greater PA behaviour, when internally regulated.

Technology seems to provide the required tools of assessing large populations, accurately, is time- and cost-effective, and therefore should be utilised in all efforts of understanding and investigating PA behaviour (Free et al., 2013, Kumar et al., 2013).

The research contained within this thesis will be published with each chapter becoming a stand-alone research study. Chapters three and four contribute to the literature in ways that would inform on the assessment of public health situations and research within public fitness centres, hence these will be aimed toward publishing in public health journals and those focused on the health and fitness industry. Chapters five and six will likely have the most impact in journals which focus on behaviour and public health, and hence will be targeted toward publishing in translational behavioural medicine and PA or exercise medicine journals. It is hoped that he journals targeted for publication will be open-access in order to have the biggest readership and hence the largest impact. A report, summarising the findings and implications of the research in this thesis will be provided to GO Fit so they can better understand and influence the PA behaviour of its' members, and non-members who aim to improve their PA behaviour. Further, this thesis will be published by Coventry University and hence will be available with free-access.

7.4. Reflection

The previous five years of this PhD project have been an extremely rewarding experience, and provided me with an invaluable insight. I have had to develop greatly my professional research skills, and academic proficiency. Shifting my focus away from athletes to a wider population, and improving health rather than performance is something that I have found very interesting, rewarding and aligned with what I am passionate about. I have developed a strong knowledge of understanding PA levels across Europe, as well as the impact CVD has. I once believed that working in high-level sport would be the best thing for me, but I have since adapted and found the public health industry just as exciting and interesting, but more importantly, rewarding. In particular, my writing has vastly improved throughout this process. Considering my previous writing experience, which was basic in the context of scientific research, I have gained a better understanding of how to structure an argument, critically analyse my work as well as others', and write for publication. As I develop as a researcher, the tools and experiences I have gained during my PhD, will continue to be used to further improve my writing in the future.

The changes and turbulence of this PhD project have been extremely challenging for me both personally and with the completion of this project. For periods of time there has been large uncertainty about the direction of the project, which investigations were to be performed and the logistics of navigating and performing such a large and ambitious project across multiple nations. Hence, I have had to adapt and learn to be proactive in directing this project and my professional life simultaneously. Again, these are experiences which have helped me improve and grow, in all aspects, helping me gain a new perspective on how to be productive, prioritise different tasks and where to put my energy and effort.

In many aspects I feel lucky to have had these experiences. For approximately two years, I have lived and worked in Madrid, somewhere that will always feel like a home to me. I have been able to travel between England and Spain, and attend an international conference in The United States of America. None of which would have been possible without the current project and support from the University, the staff and the projects' partners and collaborators.

I am determined to continue to work within the area of my PhD and develop further as a scientific researcher. I would like to use my skills and knowledge in a teaching capacity at some point beyond my PhD study, as this is an occupation which has always interested me and one I believe would be challenging and help me progress as an academic member of staff. I am very passionate about continuously learning throughout my life, and hence I believe that this area of research will continue to develop novel methods and investigations within CVD and PA. I would also like to use my experience and voice to advocate for higher education and postgraduate education as an available and achievable option to students.

Chapter 8. Project Partners

Partners of the research project

- GO fit & Ingesport - INGESPORT HEALTH & SPA CONSULTING S.L. Campus Empresarial Arbea. Edificio 4 Crta, Fuencarral, 28108 Alcobendas (Madrid).

- Technogym - TECHNOGYM S.p.A. Via Calcinaro, 2861, 47521 Cesena (FC). As a partner of the fitness centres used in this project, they provided complimentary “Wellness Keys” to participants in the pilot trial outlined in chapter six.

- European Commission (2008). *EU Physical Activity Guidelines*. Brussels: European Commission

Research Team

The lead researcher of this work is Brett Staniland.

Director of Studies was Dr Elizabeth Horton.

Supervisory team consisted of: Professor Alfonso Jimenez (Formerly Director of Studies) and Dr Gordon McGregor.

Researchers within the GO fit LAB are: Maria Ayuso (Lab Coordinator); Dr Jorge Lopez; Ismael Serrablo; Isabel-Maria Sanchez Lorente; Tamara Iturriaga (PhD research students).

Chapter 9. Appendices

9.1. Declaration of Helsinki

Declaration of Helsinki – Ethical principles for Medical Research involving Human Subjects.

9.2. Large Scale Survey Copy (Spanish)

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9.3. Participant Information Sheet (Spanish)

Hoja de información para el participante

Título del estudio: Hábitos de ejercicio de los miembros del gimnasio público y el impacto en los indicadores de salud pública.

Responsable del estudio: Alfonso Jiménez, Brett Staniland

1. **Propósito y explicación del estudio.**

El objetivo principal de GO fit Lab es la creación y supervisión de programas confiables y seguros destinados a mejorar la salud de todos los grupos.

Para este proyecto, le pediremos que complete cuestionarios basados en su estilo de vida actual y hábitos de ejercicio. Estas preguntas provienen de parte de una encuesta más amplia administrada por GO fit anualmente para informar los modelos de negocio y la estrategia, así como para proporcionar información sobre los miembros.

A través de las respuestas obtenidas de estas preguntas, nuestro objetivo es establecer un vínculo que surja de visitar el gimnasio regularmente. Éstos incluyen; disminuir su riesgo de enfermedades, así como la cantidad de veces que visita el médico y la cantidad de tiempo que debe ausentarse del trabajo por enfermedad.

Hay aproximadamente 18 preguntas en la encuesta en total y para este proyecto de investigación solo requerimos las respuestas de 6 de estas.
La duración de los test será de aproximadamente 1 hora. Todos los test serán desarrollados por el investigador principal o por su equipo de expertos, los cuales han sido entrenados para llevar a cabo estas pruebas de forma rigurosa.

2. **Riesgos y molestias de los participantes**

Este proyecto tiene un riesgo muy bajo. Todos los datos recabados, todos serán anonimizados para que no se puedan identificar a los participantes. Los datos se guardarán en un dispositivo seguro y solo los investigadores principales tendrán acceso a ellos.

3. **Responsabilidad de los participantes.**

Es importante que responda a las preguntas honestamente, ya que estas respuestas servirán para informar a los investigadores sobre la prevalencia de enfermedades y el impacto de las visitas regulares al gimnasio en la salud pública.

4. Beneficios esperables.

Los resultados obtenidos en el estudio serán utilizados para identificar los efectos del ejercicio en los factores de riesgo cardiovascular. Usted podrá experimentar cambios beneficiosos en su salud y bienestar, aunque el principal objetivo de este estudio es investigar sobre cuál es el programa de ejercicio más efectivo para reducir el riesgo cardiovascular y así poder mejorar los programas de ejercicio futuro.

5. PREGUNTAS

Le animamos a realizar cualquier pregunta que considere pertinente sobre los procedimientos empleados en las diferentes pruebas o sobre los resultados obtenidos. Si algo le preocupa o tiene dudas, por favor, no dude en pedirnos más explicaciones.

6. USO DE LA HISTORIA MÉDICA Y PROTECCION DE DATOS.

Este estudio no pretende acceder a ningún historial médico. La información obtenida en este estudio se tratará y se usará confidencialmente según describe la Ley Orgánica 15/1999 de Protección de Datos de carácter personal y la Ley 41/2002, de 14 de noviembre, básica reguladora de la autonomía del paciente y de derechos y obligaciones en materia de información y documentación clínica. Así mismo, sus datos serán tratados conforme al Reglamento General Europeo de Protección de Datos. No se dará ni revelará ninguna información sobre su persona a terceras partes sin su consentimiento previo por escrito.

Su participación en el estudio es totalmente voluntaria. Lea toda la información que se le entrega en este documento y haga todas las preguntas que necesite al investigador antes de tomar una decisión.

Si usted tiene dudas sobre el estudio o quiere conocer los resultados del estudio, podrá contactar con los investigadores.

Alfonso Jimenez – alfonso.jimenez@coventry.ac.uk

Brett Staniland – stanilab@uni.coventry.ac.uk

O, por favor, visite el GO fit Lab dentro del GO fit Vallehermoso, Av. de Filipinas, 7, 28003 Madrid, España

He leído este formulario y entiendo los procedimientos de las pruebas que realizaré, así como sus posibles riesgos o incomodidades.

Yo ____, con DNI, ____________he sido informado de que mis datos personales serán incorporados a un fichero titularidad de las empresas que forman parte de GO fit http://www.go-fit.es/AvisoLegal/ con la finalidad de elaborar un estudio de los hábitos de vida, permitiendo adaptar medidas para mejorar el estado de salud de la población.

He sido informado de que mi nombre y apellidos no aparecerán en ningún informe o documento relativo al estudio y no serán revelados a personas externas al proceso de investigación. Por lo que, doy de forma libre mi consentimiento a que los datos obtenidos puedan ser tratados conforme a los términos indicados anteriormente y difundidos con fines científicos de forma anonimizada.

En cualquier momento podrá ejercer sus derechos de acceso, rectificación, cancelación y oposición así como revocar del consentimiento mediante la remisión un escrito acompañado de copia del DNI o firmado electrónicamente a la siguiente dirección Campus Empresarial Arbea. Edificio 4 Crta. Fuencarral – Alcobendas km.3,8 28108 Alcobendas (Madrid) o en la dirección de correo electrónico *GO fit.lab@ingesport.es*

Tomando toda la información en consideración y entendiendo todo lo que el escrito expone, OTORGO libremente mi CONSENTIMIENTO para la participación en este estudio.

Fecha:

Fecha: Fdo:

9.4. International Physical Activity Questionnaire - Short Form.

(Retrieved from https://journals.plos.org/plosone/article/file?type=supplementary&id=info:doi/10.1371/journal.pone.0219193.s010)

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

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SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

9.5. PAR-Q & YOU

9.6. Cardiovascular Risk Stratification Questionnaire

9.7. Lower and Upper Estimates of Truncated PA Levels

Table 25: Comparison of Truncation of PA levels with lower estimate truncation, upper estimate and standard truncation method used in study.

	GO fit Members	**EU 28**	**Spain**
Lower Estimate Truncated PA (MET Mins per Week)	2608 ± 2129.6[¥]	1852.39 ± 2244.71[ƛ]	752.53 ± 847
Higher Estimate Truncated PA (MET Mins per Week)	3610.88 ± 2317.85[¥]	2881.13 ± 2463.42	3085.06 ± 2573.69
Truncated PA (MET Mins per Week)	*3099.78 ± 2204.69*[¥]	*2355.61 ± 2331.19*	*2537.19 ± 2414.19*

[¥]Significantly greater than EU28 and Spain ($p < 0.001$), [ƛ]Significantly greater than Spain, ($p < 0.001$).

9.8. CONSORT 2010 Checklist

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