DOCTOR OF PHILOSOPHY

An integrated intervention model to improve behavioural change in inactive members of fitness centres

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Award date:
2022

Awarding institution:
Coventry University

Degree of Doctor of Philosophy (PhD)

Coventry University, in collaboration with Ingesport Health & Spa Consulting SL

An integrated intervention model to improve behavioural change in inactive members of fitness centres

by

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September 2021

A thesis submitted in partial fulfilment of the University's requirements for the Degree of Doctor of Philosophy (PhD)

Certificate of Ethical Approval

Applicant:

Jorge Lopez Fernandez

Project Title:

Intervention content for increasing physical activity levels in fitness centres based on the Behaviour Change Wheel model. A pilot test.

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

Date of approval:

11 April 2018

Project Reference Number:

P60981

Certificate of Ethical Approval

Applicant:

Jorge Lopez Fernandez

Project Title:

A prospective study to explore the validity of the COM-B model for Exercising in Fitness Centres

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

Date of approval:

21 August 2019

Project Reference Number:

P93619

Certificate of Ethical Approval

Applicant:

Jorge Lopez Fernandez

Project Title:

The Exercise Behaviour in Fitness Centres Questionnaire. Design and validation of a questionnaire to identify what inactive members of fitness centres need to increase their exercise levels

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

Date of approval:

21 August 2019

Project Reference Number:

P93622

To my family and friends

I challenged myself as never before, but…

I never would have reached the end of this road without your unconditional support

Declaration

The work submitted within this thesis has been undertaken during the period of my registration. I declare that this work is my own, conducted by myself with assistance where acknowledged.

Acknowledgements

Hereby, I desire to transmit my sincere gratitude to all the people who somehow have contributed to the success of this work. Firstly, I would like to acknowledge the contribution of Prof Alfonso Jiménez for giving me the chance to complete this project and for supporting me in the different research activities I took part in during this PhD. His guidance and ability to involve the relevant people in each stage of my project made me possible to complete this work. Also, I acknowledge the contribution of Dr Elizabeth Horton for taking the responsibility of being my first supervisor and Gemma Pearce for guiding me in my last PhD year. Their comments and feedback significantly helped me to complete this PhD journey. Finally, I do not forget Dr Lou Atkinson, as she guided me during the first period of my thesis.

On the other hand, I must thank Gary Liguori and Lauren Connell for giving me the opportunity of completing this project at the University of Rhode Island and for their valuable contribution to my project and my personal growth. Furthermore, this thesis would not have been possible without the support of my colleagues from Coventry University and GO fit Lab. In particular, I want to thank Nadja Willinger for her valuable advice and incalculable help to my project; Ismael Serrablo for his help and company; María Ayuso for her continuous support at GO fit Lab; Dr Alejandro Lopez Valenciano for his help and contribution to my first empirical chapter; and Dr Xián Mayo for helping me with the statistics.

I neither forget my mates from GO fit Vallehermoso. I can only mention some of you (Alvarito, Marta, Mario, Yaiza…), but you all have contributed to my personal growth. I also extend my gratitude to the IGOID group team with Leonor Gallardo, Javier Sánchez and Jorge García ahead because without them, I would never be the researcher I am. Finally, with special affection I want to thank my parents and brothers for all the time I have taken from them and for their unconditional support; my friends Iván, Miguel, Rubén and Omar for been always there; and Laura and Noa for accompanying me in this difficult adventure. Also, I thank Isabel Galvis for taking me in her home as well as Chiqui, Coco, Jimmy and Layla María for taking care of me when I needed it most. I will not be able to thank you enough for all your support.

To all of you, thank you very much.

Abstract

Background: The physical inactivity (PIA) prevalence in adults is not improving. Fitness centres (fitness centres, leisure centres, gyms, and any other semi- or non-structured PA providers) are part of the solution as they are a major contributor to the built environment and are used by thousands of adults to start or maintain a physical activity (PA) behaviour. However, it remains unclear how to effectively promote and maintain PA in these populations.

To promote PA at fitness centres issues like the low attendance rate (1.1 to 5.6 times/month), the high dropout levels (>60% within the first 3 months), and the difficulties for monitoring PA need to be addressed. Attendance is a more feasible behaviour to target and monitor, and might increase the members' PA levels, but research in this regard is scarce. Behaviour change models like the COM-B Model might help to identify the barriers for attendance, while the Behaviour Change Wheel (BCW) framework might work to inform the developing of the intervention targeting attendance. Therefore, the aims of this thesis are to explore the PA participation at fitness centres, to identify the main barriers and determinants for attendance fitness centres and to develop a behaviour change intervention according to the BCW to target attendance rate at fitness centres.

Methods: Three empirical chapters (Chapters 3 to 5) were conducted. Chapter 3 examined the PA levels from a database with 3,627 members of Spanish fitness centres and the PA levels reported in the Eurobarometer 472 for the Spanish population (n=1,002). This comparison was performed considering factors like the age (18-29 years; 30-44 years; 45-59 years; 60-69 years; ≥70 years), gender (men or women), or the origin of the performed weekly PA (i.e., waking-PA, moderate-PA, or vigorous-PA). The PA levels were analysed using the International Activity Questionnaire short version (IPAQ-SF), and respondents were grouped into Low-PA (Inactive), Moderate-PA, and High-PA according to the criteria set for the IPAQ-SF.

Chapter 4 designed and validated a questionnaire for measuring factors influencing attendance at fitness centres using the COM-B Model. Three phases were performed: i) content generation of the questionnaire items through literature searches and focus groups, ii) expert review of the relevance and clarity of the items to determine sufficient construct validity, iii) assessment of content validity and internal reliability through the administration of an online survey to 180 participants from British fitness centres and 430 participants from Spanish fitness centres.

Chapter 5 developed a general intervention to target attendance at fitness centres. The BCW was used as a framework to inform the intervention development. An iterative approach of four iterations were performed to develop the intervention and the Theoretical Domains Framework (TDF) was used to underpinning the mechanisms of change. The questionnaire developed in chapter 4 was used to inform the main determinants and barriers for increase attendance to fitness centres members.

Results: Fitness centres' members showed lower prevalence of PIA and a higher prevalence of High-PA than the general population regardless the age and gender ($p < 0.05$). However, women were less active than men in both studied datasets ($p < 0.05$). Low-PA group and Moderate-PA group from the Eurobarometer dataset reported >70% of their total MET-minutes/week from walking-PA whilst those fitness centre's members reported significant higher engagement in vigorous-PA.

Chapter 4 shows a final version of the questionnaire with 35-items approved in the expert review with acceptable construct validity (e.g., Aikens' V for relevance and clarity ≥ 0.97). However, this questionnaire failed the content validity and internal reliability analysis. A shorter version of 17-item questionnaire showed acceptable validity and internal reliability (e.g., confirmatory factorial analysis: CMIN/DF = 204; CMIN = 175.497; DF = 86; CFI = 0.965; NFI = 0.919; RMSEA = 0.50; PClose = 0.457).

Chapter 5 identified low-attendance members (< 2 access/week) that reports low-PA levels as the members who might benefit the most from increasing their attendance rate. On the other hand, each item from the questionnaire developed in Chapter 4 was linked to the most promising intervention functions and behaviour change techniques. Furthermore, a mode of delivery for these behaviour change techniques and an example of how to do it was identified.

Discussion and conclusion: Fitness centres may play a key role to address PIA as they engage most of their members in regular PA, including women and older adults. Also, members seem to be more active and perform more vigorous-PA than the general population. However, gender and age differences exist in this population, therefore, attention to these factors should be made. Attendance might be an effective way to address PIA at fitness centres. The 17-items questionnaire developed in Chapter 4 has acceptable reliability and validity, so it might be used to develop future interventions targeting members' attendance. Chapter 5 describes the first structured intervention model to enhance attendance rate in low-attendance-and-inactive members of fitness centres. Further research on the testing of the intervention model defined in Chapter 5 in a fitness centre

setting could provide a structure and evidenced-based intervention which can be implemented at scale.

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Publications

Papers published

López Fernández, J., López-Valenciano, A., Mayo, X., Horton, E., Clavel, I., Liguori, G., & Jiménez, A. (2021). Comparative analysis of reported physical activity from leisure centres' members versus the general population in Spain. *BMJ Open, 11*(6), e043963. doi: 10.1136/bmjopen-2020-04396

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López Fernández, J.; Bohlen, L. C.; Liguori, G.; Horton, E.; Atkinson, L.; Jiménez, A. (2020). *Design of a Questionnaire to Support Behaviour Change in Fitness Centres*. In ACSM 68th Annual Meeting. San Francisco, California, USA.

López-Fernández, J.; Atkinson, L.; Serrablo, I.; Ayuso, M.; Horton, E.; Mayo, X.; Jiménez, A. (2019). *Designing a behaviour change questionnaire to address physical inactivity of leisure centres' customers. a pilot test*. In 24th Annual Congress of the European College of Sport Science (ECSS). Prague, Czech Republic.

López-Fernández, J.; Atkinson, L.; Horton, E.; Jiménez, A. (2018). *A new Intervention content for increasing physical activity levels in fitness centres based on the Behavioural Change Wheel model*. In 7th International Society for Physical Activity and Health Congress (ISPAH) 23rd Annual Congress. London, UK.

López-Fernández, J; Staniland, B.; Sánchez, I.; Iturriaga, T.; Ayuso, M.; Horton, E.; Atkinson, L.; Mann, S.; Liguori, G.; Jiménez, A. (2018). *Weekly Structured Physical Activity Program Enhances Short-term Retention of Middle-aged Adult Fitness Centre Users*. In ACSM 66th Annual Meeting: Minneapolis, Minnesota (USA).

List of Abbreviations

Aiken's V: Aiken's Item Content-Relevance Index

AVE: average variance extracted

BCTs: Behaviour change techniques

BCW: Behaviour Change Wheel

CFI: The Comparative fit indices

CMIN: The $\chi 2$ value

CMIN/DF: The $\chi 2$ value/degrees of freedom

COM-B:Capability, Opportunity, Motivation - Behaviour

CR: Composite reliability

CVI: The Index of Content validity

DARFC: Determinants of Attendance Rates in Fitness Centres questionnaire.

DF: The degrees of freedom

EU: European Union

IPAQ-SF: The International Physical Activity Questionnaire short form

LTPA: leisure-time physical activity

MET: metabolic equivalent

MVPA: Moderate-to-vigorous Physical Activity

PA: physical activity

PA: physical activity

PClose: the *p* of close fit

PIA: physical inactivity

RCT: Randomised Controlled Trial

RMSEA: Root mean square error of approximation (RMSEA

RVC: The Coefficient Validity Ratio

SD: standard deviation.

SCT: Social Cognitive Theory

SDT: Self-Determination Theory

SRMR: standardised root mean square

TTM: Transtheoretical Model

TPB: Theory of Planned Behaviour

WHO: World Health Organisation

Chapter 1

Introduction

This chapter briefly introduces the gap addressed within this thesis and provides context and rationale for the three empirical research works conducted. This chapter also displays the statement of purpose.

1.1. Doctoral Research context

The current Doctoral Research is part of a collaboration agreement between Ingesport Health & Spa Consulting SL (a Spanish company focusing on the management of large fitness centres) and Coventry University. One of the main objectives of this agreement was to design an integrated intervention model to improve behavioural change in inactive members of fitness centres. To do so, the predoctoral research project that involves this Doctoral Research was born, which was funded by both entities, Ingesport Health & Spa Consulting SL and Coventry University.

The different studies that composed this Doctoral Research have been developed by the author of this doctoral thesis. However, this project was funded by both Ingesport Health & Spa Consulting SL and Coventry University. So, it was developed according to the interests of both organizations. The three empirical works included in this Doctoral Research has been conducted and developed at: The GO fit Lab®, a private space for researching set up by Ingesport Health & Spa Consulting at the facilities of GO fit® Vallehermoso (Madrid, Spain); the Faculty of Health and Life Sciences at Coventry University (Coventry, UK); and the College of Health Sciences at the University of Rhode Island (Rhode Island, USA). Furthermore, these empirical works have been developed with the collaboration of external researchers, whose contribution is acknowledged accordingly. The studies conducted in this doctoral thesis were approved by an external ethical committee according to the latest version of the Helsinki Declaration (P93622; P93619; and P60981).

The fitness industry is encompassed by many different business models according to factors like company characteristics (i.e., public, for-profit, non-profit organizations), membership fee (i.e., low cost, medium, premium), size and typology of the facility (e.g., large facilities, facilities without swimming pool, small facilities), etc. Many of these business models offer their service in a facility specifically designed to promote different types of PA. These facilities can be named gyms, studios, fitness centres, wellness centres, leisure centres, community centres, etc., based on some specific characteristics. However, all of them are part of the same industry and share many similar characteristics (i.e., membership, semi-structured and non-structured exercise offers, etc.). In this Doctoral Research, the words “fitness centre” and “leisure centre” refer to all these business models and facilities. In this regard, the use of the term “leisure centre” in Chapter 3 instead of fitness

centres is due to it was a most accurate word for this case then fitness centre due to data origin. But it is used referring to the same industry and business models as when using “fitness centres”.

1.2. Introduction

The current international guidelines for physical activity (PA) from the World Health Organisation (WHO) recommend the adults aged between 18 to 64 years old to perform at least 150 minutes per week of a combination of both moderate and vigorous PA (MVPA) or to perform at least 75 minutes a week of vigorous physical activity. In addition to this PA it is also recommended the adults to perform strengthening activities of big muscle groups for at least two days a (World Health Organization, 2020). Accordingly, meeting these recommendations is equal to be active. On the contrary, not meeting these guidelines is equal to be physically inactive or physical inactivity (PIA) (Ding et al., 2016, Dumith et al., 2011, Van der Ploeg and Hillsdon, 2017, World Health Organization, 2020). In the past, PIA and sedentariness or sedentary behaviour were somehow considered synonymous and, in 2017 there were still a current that consider both similar terms (Van der Ploeg and Hillsdon, 2017). However, there are now a global consensus on PIA and sedentary behaviour are different terms and, therefore, different behaviours (Van der Ploeg and Hillsdon, 2017, World Health Organization, 2020). Accordingly, sedentary behaviour represents those behaviours performed in sitting, reclined, or lying position with a low level of energy expenditure (≤1.5 METs) (Tremblay et al., 2017). Evidence show that PIA and sedentary behaviour have a different impact on adults’ health (Van der Ploeg and Hillsdon, 2017, World Health Organization, 2020). Furthermore, while a threshold exists to identify the inactive population, sedentary behaviour has not a threshold or cut-off point, although some authors suggest 7h30min as the cut-off point for daily sitting time (Jelsma et al., 2019, López-Valenciano et al., 2020, Milton et al., 2015). Consequently, it can occur that a person to be active but accumulate many hours of sedentary behaviour or the other way around, accumulate low levels of sedentary behaviour and be inactive. Based on this, different approaches might be needed to address these different behaviours. This Doctoral Research is interested in addressing PIA and promoting PA, so no attention is made to sedentary behaviour.

Meeting the guidelines for PA has been related to many health-related benefits: e.g., increase of fitness, emotional wellbeing and disease prevention, reduction of the risk of premature death or developing non-communicable disease, and healthier ageing process (American College of Sports Medicine, 2013, Lee et al., 2012, Moore et al., 2016, World Health Organization, 2018a). Moreover, these benefits are widespread to the general public through the education system, the local and national and international health institutions and mass media (Annesi, 2003, European

Commission, 2016, World Health Organization, 2018a). However, the available records from national and international organisations suggest that still around 27.5% of the worldwide population is inactive (Guthold et al., 2018). Furthermore, the PIA prevalence seems to be higher in women, elderly, people with disabilities, people with low-socioeconomic status, etc. (Bauman et al., 2009, Carlson et al., 2010, Guthold et al., 2008, Mayo et al., 2019, Mielke et al., 2018, Schüz et al., 2017, World Health Organization, 2020). While high-developed regions like the European Union show higher PIA levels than low- and middle-developed regions (Guthold et al., 2018, Mayo et al., 2019). Therefore, although a general approach to the problem can be made, some special actions are required to address some of these social-demographic-economic gaps in PIA.

In order to increase the adults' PA levels, several works have studied the facilitators and barriers to PA (Kuehl et al., 2016, Schwetschenau et al., 2008, Withall et al., 2011), and how to implement effective interventions to target PIA (Fjeldsoe et al., 2011, Howlett et al., 2018, Murray et al., 2017, Pereira et al., 2015, Young et al., 2014). However, most of these works have been applied in controlled environments in which participants have not a clear exit pathway to maintain the achieved behaviour or PA levels once the intervention is over (Pavey et al., 2011). For that reason, some authors suggest focusing the efforts in promoting PA in real-world settings (Beedie et al., 2014, Hohmann and Shear, 2002). The fitness and leisure industry can be considered as a real-world setting because it is part of the built environment and fitness centres (i.e., fitness centres, wellness centres, leisure centres, community centres, gyms, studios, etc.) are used for large adults' population to start, restart or maintain a PA habit (Beedie et al., 2014, Hohmann and Shear, 2002, IHRSA, 2020, Middelkamp et al., 2017). The potential impact of these centres on adults' PA levels is stressed by the continuous growth of this sector in most regions, including the European Union Region (IHRSA, 2011, IHRSA, 2020, Middelkamp et al., 2017). Furthermore, these centres have evidenced to engage a large number of women (López-Fernández et al., 2021), elder people and even people with specific health condition (Beedie et al., 2016, Watts et al., 2017). While increasing the accessibility to these centres seems to improve the PA levels of the community (Higgerson et al., 2018).

The evidence, therefore, suggest that most leisure centre members are adequately active when analysing self-reported PA (Schroeder et al., 2017), and they are more active than non-members counterparts (Schroeder et al., 2017). Nevertheless, the lack of normative values and comparisons with the general population according to some sociodemographic factors like age or gender do not allow to reach this conclusion. Furthermore, although new members attest to low levels of PA before enrolling in a fitness centre (Sperandei et al., 2016), it has been reported that

many of them do not meet the PA guidelines after a year of enrolment (Gjestvang et al., 2019b). Accordingly, before implementing interventions promoting PA among fitness centres, it is necessary to know the prevalence of PA among fitness centres' members.

One of the main limitations of implementing PA interventions at fitness centres is that most PA offered at these centres is in form of semi- and non-structured PA what hinder monitoring PA behaviour of participants beyond the information coming from the access point (Clavel et al., 2020, Middelkamp et al., 2017). In addition, the monthly average attendance rate between 1.1 to 5.6 times/month while up to 63% of the members leave the fitness centres in the first three months after joining (DellaVigna and Malmendier, 2006, Middelkamp et al., 2016, Sperandei et al., 2019). Thus, implementing intervention targeting PA at these centres is challenging and need to overcome these limitations. In this regard, increasing the attendance rate does not necessarily imply the person to do PA. However, it is likely that an increase of the attendance level result in an improvement of the performed MVPA. Thus, targeting attendance might be a more feasible behaviour to target and to follow-up than PA. Furthermore, it might reduce the dropout rate at fitness centres and increase the time a person remains as a member (Clavel et al., 2016, Clavel et al., 2020). So, targeting attendance rate might poses a great potential for both public health and the fitness sector.

1.3. Aims and objectives

The aim of this Doctoral Research was to study the prevalence of different levels of physical activity among fitness centres members, to design a questionnaire to identify the main barriers for attendance fitness centres and to develop a behaviour change intervention that targets attendance rate at fitness centres. To address this aim, three research objectives and studies were conducted. The specific objectives of these studies were:

- **Study 1 objectives**: a) to analyse the physical activity levels of the members of a fitness centre operator according; b) to compare the prevalence of the different levels of physical activity between fitness centres' members and the general population considering the gender and age; c) to explore the intensity-origin of the PA in both fitness centres' members and the general population.
- **Study 2 objectives**: to design and validate a questionnaire for measuring factors influencing attendance at fitness centres.

- **Study 3 objectives**: to develop an intervention to support members of fitness centres to increase their attendance rate as a way to improve their current levels of physical activity.

1.4. Structure of the thesis

The structure of this thesis is divided into eight chapters. The three empirical chapters (chapters 3 to 5) have been written as manuscripts for journal submission.

- Chapter two: a review of the current literature in order to provide the thesis rationale.
- Chapter three: the first empirical research examining the prevalence of different levels of physical activity among fitness centres members and compares them with the general population.
- Chapter four: the second empirical research with the design and validation of a questionnaire to identify the key factors to improve attendance rate among fitness centres' members using the COM-B model.
- Chapter five: the design of an intervention to improve attendance rate in fitness centres.
- Chapter six: general discussion of the research in relation to the literature and theory, strengths and limitations, implications for research, practice and policy and conclusions.
- Chapter seven: the reference list used through this Doctoral Research
- Chapter eight: Appendix.

Chapter 2

Literature Review

The purpose of this chapter is to examine the literature behind the context in which this thesis is focused in order to set the rationale for this doctoral thesis. This chapter is divided into five sections. Section 2.1. explores the definition physical activity, the definition of different types of physical activity and the reasons to promote physical activity among the adult's population. Section 2.2. explores the prevalence of PIA in Europe and the consequence of being physically inactive. Section 2.3. describes the evolution of international and action plans for physical activity. Section 2.4. discuss the use of different behaviour change frameworks to promote physical activity and address PIA, including the behaviour change framework selected in this Doctoral Research. Section 2.6. discusses the role of fitness, leisure, sports centres, and other exercise providers in promoting leisure-time physical activity among the adult's population and therefore in reducing the prevalence of PIA among this population. It is important to consider that this section does not aim to provide a full revision but to provide a sufficient vision of these topics and to draw the context in which the present doctoral thesis has been developed.

2.1. Physical activity: definition, types, and health benefits.

Physical activity (PA) is a broad term that encompasses any bodily movement produced by the skeletal muscles that results in a substantial increase in energy expenditure (Bouchard and Shepard, 1994, World Health Organization, 2020) and according to the intensity it can be categorised as light (≥1.5 – <3.0 metabolic equivalent of tasks [METs]), moderate (≥3.0 – <6.0 METs) or vigorous/heavy (≥6.0 METs) (Courneya and Friedenreich, 2011). Further classification or types of PA can be made according to factors like the characteristics of the activity (i.e., non-structured, semi-structured, structured). This is the case of the term "exercise", which has been defined as a succession of structured, planned, and repetitive PA to maintain or improve physical fitness (Caspersen et al., 1985). Also, PA can also be divided according to the time it is performed (i.e., weekday or weekend) or the context (e.g., at work [occupational PA]; at leisure [leisure-time PA]; at home [household PA]; or, when moving from one place to another [commuting PA]). (Byambasukh et al., 2020, Florindo et al., 2009). Thus, PA cover all physical activities regardless of the environment these activities are performed, their structure, the existence or absence of a previous plan, the reason to perform them or the intensity.

Doing regular PA has been associated with multiple health benefits such as lower likelihood of developing type 2 diabetes, cardiovascular and coronary diseases, osteoporosis fractures, or different types of cancer (colon, breast or prostate) (Chodzko-Zajko et al., 2009, Giovannucci et al., 2005, Lee et al., 2012, Moayyeri, 2008, Moore et al., 2016, Patel et al., 2003, Pereira et al., 2015,

Roumen et al., 2009, World Health Organization, 2020). Also, because it is associated with a delay of the onset of dementia, a positive influence on mental health, a lower risk of falls among older adults, an increase of body composition and a better aging process (Livingston et al., 2017, Mammen and Faulkner, 2013, Schuch et al., 2016, Sherrington et al., 2008, Stonerock et al., 2015). Furthermore, promoting PA among the adult population would also bring benefits for national health care systems and both private and public companies by reducing the burden of treating diseases caused by a lack of sufficient PA (Ding et al., 2016) and by improving the work productivity and the work absence (Pereira et al., 2015, Virtanen et al., 2018). Consequently, increasing the PA levels of adults have positive effect in many different areas besides health.

To get the health-related benefits of PA, it has been recommended that adults perform at least 150 minutes a week of a combination of both moderate and vigorous PA (MVPA) through the week such as brisk waking, cycling, running, etc. or perform at least 75 minutes a week of vigorous physical activity like running (World Health Organization, 2020). Although to achieve higher health-related benefits, it is recommended to do as many MVPA as possible through the week and exceed PA's recommended levels (Piercy et al., 2018, World Health Organization, 2020). And, if possible, adults should try to partake in moderate PA for at least 30 min a day (UK Chief Medical Officers, 2019). In addition to MVPA, adults should also conduct strengthening activities of big muscle groups for at least two days a week (World Health Organization, 2020). Despite these recommendations, evidence shows that any activity is better than none, so just increasing current PA levels can lead to positive health improvements even if the increment is not enough to meet the current guidelines (UK Chief Medical Officers, 2019). Also, it has been suggested that any duration bout applies to get benefits from PA, and there is no need to accumulate at least 10 min of activity (UK Chief Medical Officers, 2019).

2.2. Physical inactivity and its consequences

The opposite of being physically active is the so call “Physical inactivity” (PIA), which has been designed as default of the weekly Global Recommendations on PA (World Health Organization, 2020). However, some guidelines, such as those from Sport England, suggest that inactive people are those who do not engage in at least 30 min of moderate PA a week as the average. On the contrary, those who perform 30 to 149 min of moderate PA per week as the average are fairly active (Sport Engand, n.d.).

Contrary to PA, PIA has proved to have a negative impact in humans health as it contributes to develop the so called non-communicable diseases (NCDs) such as obesity, cardiovascular and coronary disease, type 2 diabetes, and different types of cancer (La Vecchia et al., 2012, Lee et al., 2012). Furthermore, it has been related to premature death, poorest aging and higher risk of falls (Carlson et al., 2018, Lee et al., 2012, Sherrington et al., 2008, Taylor, 2014). In fact, in 2012, PIA was estimated to be responsible for 12% for type 2 diabetes, 8% for colon cancers and 9.7% of the annual mortality in Europe (Lee et al., 2012).

PIA has been associated with a high cost for the national health care systems as the burden to the healthcare system of treating diseases caused by a lack of sufficient PA within the European region was attributed to being around $11.743 and $3.829 million/year in direct and indirect cost respectively (Ding et al., 2016). Also, PIA has been related to lower work productivity and lower work absence (Pereira et al., 2015, Virtanen et al., 2018). Consequently, reducing the PIA levels of adults would not only increase the health of the population but would also alleviate the health care public systems by reducing the waiting list or the cost from treating PIA-related diseases and would have a positive impact in business in form of higher productivity and lower work absences.

Based on the increased evidence of the impact of PIA in modern societies, the WHO have encouraged all the state members to reduce their PIA prevalence by 10% by 2025 and 15% by 2030 (World Health Organization, 2013, World Health Organization, 2018a). In addition, they have developed the Global Action Plans to provide these nations with different guidelines (World Health Organization, 2013, World Health Organization, 2018a). The European Union have also developed several initiatives to support the members in addressing PIA (European Commission, 2016). Consequently, addressing PIA has become in a global priority.

2.3. Guidelines for physical activity, Action Plans promoting physical activity and physical inactivity prevalence.

To support the adults to get the health-related benefits of PA, there has been several public-health guidelines for PA through the last thirty years. One of the earliest guidelines were developed by the American College of Sports Medicine (ACSM) who recommended the adults perform at least 30 min of moderate-intensity physical activity each day (Pate et al., 1995). These guidelines were developed before the Fifty-seventh World Health Assembly when the World Health Organization first recognised the importance of a global strategy for PIA prevention and recommended the

Member States develop their own national PA action plans and policies to increase physical activity levels among their populations (World Health Organization, 2010).

Despite the effort of public bodies in promoting PA among the adult population after this Assembly, the prevalence of PIA among the adult population worldwide remained relatively high within the first decade of the 21st Century (21.4%) (Dumith et al., 2011). This fact, as well as the increasing evidence about the importance of promoting PA among all population groups (World Health Organization, 2009), led the WHO to lunch the 2010 international guidelines for PA (World Health Organization, 2010). In these guidelines specific PA recommendation for three main population groups were provided: children, adults, and older adults (World Health Organization., 2010). In the case of adults, which are the group of interest in this Doctoral Research, these guidelines do not support performing 30-min of moderate-intensity physical activity each day as the earliest ACSM guidelines (Pate et al., 1995) but, to develop 150-min of moderate-to-vigorous PA (MVPA) per week and two days/week of endurance exercise of big muscular groups (World Health Organization, 2010). Furthermore, these guidelines were widespread to the general public by the education setting, the local, national and international health institutions and mass media.

The fact of 1 in 4 adults do not meet the 2010's guidelines for PA made the WHO to Global Action Plan for the prevention and control of noncommunicable diseases 2013-2020 to provide the WHO country members with several recommendations to promote different types of PA and to encourage them to reduce their current levels of PIA prevalence by 10% by 2025 (World Health Organization, 2013). A new Global Action Plan on physical activity 2018-2030: more active people for a healthier world was also launched in 2018, providing further recommendations in PA promotion and urging the country members to reduce 15% of their current levels of PIA prevalence by 2030 (World Health Organization, 2018a).

Together with these Action Plans, in 2020 the WHO updated its guidelines in order to cover the more recent evidence in this field (World Health Organization, 2020). However, in the case of adults the newer PA recommendations for adults remain relatively similar to those from 2010, although specific guidelines were developed for disabled people and pregnant women (World Health Organization, 2020). Accordingly, the 2020's guidelines recommend the adults perform at least 150 minutes a week of a combination of both moderate and vigorous PA (MVPA) through the week such as brisk waking, cycling, running, etc. or perform at least 75 minutes a week of vigorous physical activity like running (World Health Organization, 2020). Nonetheless, to achieve higher health-related benefits, they also recommend the adults to do as many MVPA as possible through the week

and exceed the PA's recommended levels (Piercy et al., 2018, World Health Organization, 2020). In addition to the aerobic PA, the 2020's guidelines also recommend the adults to conduct strengthening activities of big muscle groups for at least two days a week (World Health Organization, 2020).

Regarding Spain and the UK, which are the two countries where this doctoral thesis took part, the current guidelines for PA are quite similar to those from the WHO (UK Chief Medical Officers, 2019, National Health System, 2021, Ministerio de Educación Cultura y Deporte, 2015). According to Spanish guidelines, adults should take part in 150 min of moderate PA or 75 min of Vigorous PA, or an equivalent combination of MVPA a week (Ministerio de Educación Cultura y Deporte, 2015). This PA should be distributed through the week in as many days as possible, and each activity bout should last for at least 10 min. In addition, adults should do strength exercises (8-12 reps per big muscular group) for at least two days a week (Ministerio de Educación Cultura y Deporte, 2015). In the UK, the Chief Medical Officer and the National Health System (NHS) also recommend adults do 150 min of moderate PA or 75 min of Vigorous PA, or an equivalent combination of MVPA a week as well as performing strength activities of major muscle groups for at least two days a week (National Health System, 2021, UK Chief Medical Officers, 2019). However, each guideline has some minor differences. For instance, the Chief Medical Office encourage adults to do PA every day and acknowledge that any activity is better than none, even it last for less than 10 min, although more is better (UK Chief Medical Officers, 2019). Also, that adults should break long periods of inactivity with at least light PA. The NHS guidelines suggest adults spread PA evenly over 4 to 5 days or every day (National Health System, 2021). Additionally, adults should break up long periods of not moving with some activity.

Despite the efforts of international, national and local bodies in promoting PA, the current reports suggest that 1 in 4 adults do not meet the global recommended levels of PA (at least 150 minutes of moderate to vigorous PA [MVPA] (World Health Organization, 2020). Europe is not an exception as around 41.7% of the European population self-report low levels of physical activity (Mayo et al., 2019). Furthermore, this prevalence has increased 3.6% between 2013 and 2017 (Mayo et al., 2019), so, additional efforts are required to reduce the existing prevalence of PIA in this region and to achieve the PIA challenges set by the WHO: to reduce the prevalence of physical inactivity (PIA) by 10% by 2025 and 15% by 2030 (World Health Organization, 2013, World Health Organization, 2018a).

PIA prevalence differs among the population groups. For instance, there is a higher proportion of women that do not engage in sufficient PA compared to men, while active women usually accumulate fewer weekly metabolic equivalent minutes/week (METs) and perform less vigorous exercise compared to active men (Guthold et al., 2018, Mayo et al., 2019, Mielke et al., 2018). On average PA levels decrease with age, with older adults having a higher PIA prevalence than the younger groups (Bauman et al., 2009, Carlson et al., 2010). People living in deprived areas or having lower economical resources tended to have a higher PIA prevalence than those population groups living in richer neighbourhoods (Schüz et al., 2017). Accordingly, future interventions should include these population groups and explore groups and explore components that promote PA among them.

2.4. Physical inactivity prevalence and surveillance in Spain and the UK.

Based on the latest existing Eurobarometer survey, the PIA prevalence of Spanish adults (men: 30.0%; women: 37.2%; both: 34.0%) and British adults (men: 33.5%; women: 40.6%; both: 37.1%) is high, although this prevalence is below the average for Europe (men: 39.1%; women: 43.8%; both: 41.7%) (Mayo et al., 2019). In addition, while Spain showed an increase in PIA prevalence between 2013 and 2017 (from 28.4% to 34.0%; p = 0.01), the UK showed a non-significant decrement (from 40.6% to 37.1%; p = 0.11) (Mayo et al., 2019).

Aligned with the Health-Enhancement PA (HEPA) across sectors promoted by both the European Commission and the WHO Region for Europe, either Spain or the UK have national surveys to monitor the prevalence of PIA among adults. Furthermore, both countries have developed different national and regional strategies to reduce PIA and enhance PA among their citizens (European Commission, 2016, World Health Organization, 2018b). Therefore, there are additional surveys to Eurobarometer that should be used to know the PIA of adults from these two regions.

In Spain, the latest national survey is from 2017 and suggests around 35.28% of the population (men: 33.51%; women: 37.04%) does not meet the international guidelines for PA (men: 33.51%; women: 37.04%) does not meet the international guidelines for PA (Ministerio de Sanidad Consumo y Bienestar Social, 2017). Despite this survey being conducted periodically, further effort in monitoring the prevalence of PIA is needed to meet the commitment to HEPA strategy for the European Region (World Health Organization. Regional Office for Europe, 2016), as PA is not monitored every year and this survey is five years old. This is even more important in today's context

as remains unknown the changes in PA habits of the population within the context of the COVID-19 pandemic. There is another survey at the state scale that informs about the sports habits in this country that could be used to complement the 2017 national survey (Ministerio de Educación Cultura y Deporte, 2020). However, this survey does not inform of the prevalence of Spaniards who do not meet the international guidelines for PA, so it does not inform of changes in PA habits of Spaniards. The same happens with the European Survey of Health in Spain 2020. It provides relevant insight into PA engagement among Spanish adults, but the existing report does not inform about the prevalence of Spaniards who are not meeting the international guidelines for PA (Ministerio de Sanidad Consumo y Bienestar Social, 2020). Adding to this survey a short version of the IPAQ questionnaire or items inquiring about intensity, duration, and frequency of weekly PA might be adequate to overcome this limitation (Mayo et al., 2019, Sport Engand, 2021). On the contrary, England through Sports England has a periodic survey measuring PA and PIA prevalence among adults that are released every year (Sport Engand, 2021), proving to have a stronger surveillance system of PA habits. Based on the latest Survey (May 20/21 Report), the PIA prevalence in this region is around 39.1%, while 27,5% of adults perform less than 30 min/week of moderate PA. Therefore, further effort in enhancing PA is needed as this survey reveals similar outcomes to the latest survey conducted by the European Commission in 2017 (Mayo et al., 2019).

2.5. Behaviour change science to address physical inactivity

2.5.1. Importance of using the behaviour change science to promote physical activity

The need to develop interventions to increase adult's PA requires them to change their health behaviour. Using a psychological behaviour change framework increases the effectiveness of interventions targeting PIA (Gourlan et al., 2016, Howlett et al., 2018, Rhodes and Pfaeffli, 2010, Young et al., 2014). It is because these frameworks explain some of the mechanism of behaviour change and, therefore, help the researcher or practitioner to identify an effective way to support the desired change (Cane et al., 2012, Michie et al., 2014). Previously, many interventions failed to use an underpinning framework or define how the unwanted behaviour was addressed (Hoffman et al., 2017, Michie et al., 2013, Murray et al., 2017). Moreover, some of the selected frameworks only explained a small part of the mechanism of change, therefore unable to explain all of the aspects involved with the behaviour change intervention (Cane et al., 2012, Michie et al., 2014).

In contrast, most of the existing research targeted a limited number of people to provoke a decline in the inactive levels of the community where these studies were conducted, apart from some public health interventions (Dunkley et al., 2014, Reis et al., 2016). Furthermore, many used a methodology that cannot be converted into a large-scale intervention that makes real impacts on public health (National Institute for Health and Care Excellence, 2006). Many of these trials failed in providing participants with a clear and familiar exit pathway to keep doing the achieved physical activity behaviour once the intervention was over (Pavey et al., 2011). Although public health interventions have been able to target sufficient people (Baker et al., 2015, Hoffman et al., 2017), they do not evidence a significant improvement in the physical activity levels of the whole community (Baker et al., 2015, Laine et al., 2014, Reis et al., 2016). Thus, the challenge remains in translating the evidence-based research findings into a real-world environment that targets enough people to significantly impact the community and at the same time support the achieved change in the long-term (Beedie et al., 2014, Dunkley et al., 2014, Reis et al., 2016). Moreover, many of the previous interventions failed in defining when the behaviour change was achieved (Howlett et al., 2018, Middelkamp et al., 2016) or proposed the same approach for all participants instead of individualising the intervention content to each participant's characteristics and needs (Ogden, 2016).

To address these issues, researchers suggest implementing health interventions within real environments available by those who "need the treatment". This guarantees the ecological validity of the planned intervention and provides participants with a real long term habitual exercise pathway once the study is over (Beedie et al., 2014, Hohmann and Shear, 2002, National Institute for Health and Care Excellence, 2006, Pavey et al., 2011). In the case of PIA, these environments might be those places that offer different PA services or activities to the adult populations (e.g., sports clubs, fitness centres, leisure centres, etc.) or places that people can easily access to do some kind of PA (e.g., parks, sidewalks, etc.). Moreover, to facilitate a more accurate description of the intervention a group of authors have developed the so-called Behaviour Change Techniques (BCTs; Taxonomy v1) (Abraham and Michie, 2008, Michie et al., 2013). These BCTs are defined as the active components of the behaviour change interventions that define the way the intervention addresses the selected behaviour(s) (Michie et al., 2013). They cannot be reduced to another behaviour component and its impact on changing the selected behaviour can be observable and measurable (Michie et al., 2013). Accordingly, the BCTs have been used to identify the main determinants to promote PA among different populations, to facilitate replications and to

identify those behaviour components that better work for promoting PA (Howlett et al., 2018, Ogden, 2016, Bishop et al., 2015, French et al., 2014, Nyman et al., 2018, Olander et al., 2013).

2.5.2. Behaviour Change frameworks used to address physical inactivity

In the last twenty years, many researchers have tried to find the most efficient way to increase the physical activity levels of modern societies (Annesi, 2003, Conn et al., 2011, Hancock, 2009, Middelkamp et al., 2017, Rhodes and Nigg, 2011). However, further efforts are required as the average rate of inactive people in Europe is around 40%, with no significant improvement over time (Mayo et al., 2019). The evidence-based research findings suggest that physical inactivity should be addressed by applying a behaviour change framework since higher adherence to an active lifestyle has been observed in those interventions including a behaviour change framework than in those in which a construct of behaviour change was not applied (Annesi and Johnson, 2015, Gourlan et al., 2016, Howlett et al., 2018, Young et al., 2014). It is because these frameworks guide the researcher or practitioners to identify the relevant mechanisms for supporting the desired behaviour change and, therefore, contribute to designing a more complete and accurate intervention design (Cane et al., 2012, Jekauc et al., 2015, Michie et al., 2011).

At that point, various behaviour change theories have been used for addressing physical inactivity with some moderated outcomes. The most used frameworks are the social cognitive theory (SCT), the Theory of Planned Behaviour (TPB), the Self-Determination Theory (SDT) or the Transtheoretical Model (TTM) (Conn et al., 2011, Glanz and Bishop, 2010, Gourlan et al., 2016, Rhodes and Nigg, 2011, Middelkamp et al., 2017). However, none of these interventions has proved to be effective to address physical inactivity behaviour at the long-term (Fjeldsoe et al., 2011, Vandelanotte et al., 2007). In fact, a relatively recent review of 27 meta-analyses revealed the overall effectiveness of behaviour change is small but meaningful range ($d = 0.27$; CI = 0.17 – 0.37) (Rhodes et al., 2017). Consequently, although using behaviour change frameworks seems useful, newer behaviour change approaches may be required to design physical activity interventions that effectively impact the long-term. Below, the main paradigm, their limitations, and strengths in enhancing PA of some of these behaviours change frameworks is discussed.

2.5.2.1. The social cognitive theory (SCT)

The SCT suggest that individuals regulate their behaviour through reinforcement and control. Therefore, social influences, internal and external social reinforcement, past experiences, and self-efficacy are core variables within this theory (Bandura, 1986). Accordingly, benefits,

barriers, attitudes, outcome expectations and one's capability to perform a specific behaviour (self-efficacy, competence) are defined as main determinants for actual behaviour action (Rhodes, 2017). However, among all these variables, only self-efficacy or the perception of being capable of enacting physical activity seems to be useful to predict PA behaviour (Dishman et al., 2004, Young et al., 2014). Although, goals are also needed (McEwan et al., 2016, Young et al., 2014). A meta-analysis reported this theory accounted for 31% of the variance in PA behaviour in individuals of different ages (Yu et al., 2022); surpassing the minimum variance ($R2 \geq 0.30$) for a theory to be considered a useful framework for intervention design (Baranowski et al., 1998). However, other studies suggest the efficacy of this theory remains low and it is not greater than other existing theories (Gourlan et al., 2016) or even lower than the TTM (Young et al., 2014). One of the main limitations of the SCT is many published interventions based on this theory did not apply the theory accurately (e.g., poor linking the BCTs with the corresponding constructs, not tailoring the intervention according to all theoretical constructs of the SCT, etc.), which can bias the outcomes (Prestwich et al., 2014). Moreover, a systematic literature review with 140 studies found that applying the SCT partially or in full to target physical activity and healthy eating did reveal from null to low effectiveness in supporting the change (Prestwich et al., 2014, Prestwich et al., 2015), suggesting that different approaches need to be used to enhance behaviour change in PA.

Despite the limitations of the SCT, it is important to acknowledge the legacy of this framework (Beauchamp et al., 2019). This includes the theoretical contribution to the BCT taxonomy (Michie et al., 2013, Oyibo et al., 2018), and the fact of some conceptual aspects of the SCT has been included in subsequent theories of human behaviour [e.g., Theory of Planned Behaviour (Ajzen, 1991), Health Action Process Approach (Schwarzer, 2008), or Goal Setting Theory (Locke and Latham, 2002)].

2.5.2.2. The Theory of Planned Behaviour (TPB)

The TPB is an extension of the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1977) and is part of the social cognitive framework. This theory suggests that human behaviour is the intention to perform such behaviour (motivational component) and the perceived behavioural control (the extent to which people have control over engaging in the behaviour) (Ajzen, 1991, McEachan et al., 2011, Sniehotta et al., 2014). Furthermore, according to this model, the intention is determined by the individual's attitudes towards the behaviour (positives or negatives), the perception of what others will think if engaging in such behaviour (subjective norms), and the perceived behavioural control (McEachan et al., 2011, Sniehotta et al., 2014).

The TPB has been the dominant theoretical approach on health-related behaviour research since the eighties (Pate et al., 1995), and it has been used to predict physical activity in over 100 studies (Hagger et al., 2002, McEachan et al., 2011, Yuriev et al., 2020). Moreover, it remains one of the most used theories in behaviour change sciences (cited ≈ 90,000 times in 2019) (Yuriev et al., 2020). However, the utility and validity of TPB have been widely questioned, with some authors suggesting the retirement of this theory in favour of newer theories (Sniehotta et al., 2014). Some of the reasons for this claim is that the TPB is only based on four concepts focused on rational reasoning, and it excludes either the unconscious influences on behaviour (Sheeran et al., 2013) or the role of emotions (Conner and Armitage, 1998). Moreover, the model might be open to empirical falsification (Ogden, 2003, Smedslund, 1978) and seems to be unable to accurately communicate accumulated empirical evidence. On the other hand, a meta-analysis with 237 prospective tests found that TPB only accounts for 19.3% of the variability in health behaviour (McEachan et al., 2011). And, even though the predictivity was higher for the PA behaviour (23.9% of the variance explained), it was still low, and populations that need to engage in this behaviour the most showed lower predictive validity (McEachan et al., 2011, Sniehotta et al., 2013). Furthermore, the effectiveness of the TPB was not superior to other behaviour change approaches (Gourlan et al., 2016). Nonetheless, despite the evidence suggesting using a different model (Sniehotta et al., 2014), it is important to acknowledge the components of the TPB (intention, attitudes, subjective norms and perceived behavioural control) are still important to understand the human mechanism of change and to inform future health-related behaviour change interventions (Hagger and Chatzisarantis, 2009, Dunn et al., 1999).

2.5.2.3. Self-Determination Theory (SDT)

The SDT is a humanistic framework, and it is based on intrinsic and extrinsic rewards on an individual's motivation to execute a specific behaviour. Existing research suggest that competence, autonomy, and relatedness are the most effective domains of the SDT to support behaviour change (Deci and Ryan, 2000, Ryan and Deci, 2019). Thus, autonomous forms of regulations (higher levels of self-determinations) are related with higher levels of engagement in PA (Teixeira et al., 2012).

The use SDT in PA interventions has been suggested by some researchers (Edmunds et al., 2008). However, a recent meta-analysis showed that the SDT have modest effect on health behaviours such as PA (Ntoumanis et al., 2021). What supports the position of some authors who do not see sufficient evidence to conclude that the SDT is able to inform PA interventions (Buchan et al., 2012). One of the main critics is that other positive psychological experiences (e.g., self-esteem,

pleasure, security) seems to play a key role in variability in behaviour and well-being (Sheldon, 2011). Also, that individuals may have more than one reason for being physically active, and participants of PA intervention typically scored corresponding to the six behavioural regulations instead of just the one identified by the SDT (Markland and Tobin, 2004). Finally, there has been reported some inconsistencies in conceptualization and measurement of studies using the SDT, what might bias the outcomes (Rhodes et al., 2019). Accordingly, new approaches might be needed to develop more effective interventions enhancing PA.

2.5.2.4. The Transtheoretical Model (TTM)

The TTM is a stage-based model that suggests that individuals move through several stages when trying to adopt a specific behaviour (Prochaska and DiClemente, 1982). Thus, each stage has a particular set of psychodynamic and cognitive variables and process that have to be targeted to support the individual to move to the following stage (Marcus and Forsyth, 2009, Prochaska and DiClemente, 1982). Accordingly, this is a macro-level theoretical approach that incorporates both cognitive theories and behavioural strategies to tailor interventions to the individual (Gregory and Liguori, 2015). The most common stage model is based on five stages, but there are other stage models (Armitage and Conner, 2000).

Some reviews have suggested this theory is more effective in promoting PA than other approaches (Adams and White, 2003, Marshall and Biddle, 2001). In fact, this framework has been suggested to have higher effectiveness than the SCT (Young et al., 2014). However, other systematic reviews does not support this statement (Michie et al., 2011, Riemsma et al., 2002, Van Sluijs et al., 2006). While Adams and White (2004) suggested more than a decade ago that the stage-based models are not effective enough and newer models were needed. Despite the debate about the usedness of the TTM (Brug et al., 2004), it is still in use (Kleis et al., 2021). Nevertheless, although the TTM might still be useful, the existing limitations behind this model well deserve the exploration of a newer approach to enhance PA (Adams and White, 2004, Kleis et al., 2021, Prestwich et al., 2014, Romain et al., 2018). For instance, a recent systematic literature review that analysed 11 randomised pretest-postest studies found an inconsistent evidence to support the use of TTM on enhancing PA (Kleis et al., 2021), what suggests that this theory is not as effective as previously reported. Another main critic is the poorly implementation of this framework in many interventions seeking to improve PA behaviour (Romain et al., 2018, Prestwich et al., 2014), what can bias the outcomes. However, some studies suggest that even implementing this theory in full higher effectiveness might not be reached (Prestwich et al., 2014). Additional limitations to this model are the difficulty of assigning

individuals into the five distinct stages, the lack of temporal sequence examination in many interventions, or the lack of consideration of the social context, among others (Armitage, 2009, Adams and White, 2004). Finally, this approach was used to increase PA among members of fitness centres, but with moderate success (Middelkamp et al., 2017). Thus, considering all these limitations, exploring the use of a different framework seems to be appropriate.

2.5.3. The Behaviour Change Wheel to inform future interventions based-behaviour change addressing PIA

Despite of the several behaviour change theories that can be used to inform intervention development to promote PA and address PIA behaviour, the evidence does not support the use of a theory over others (Gourlan et al., 2016, Hagger and Weed, 2019). Some additional reasons for the limitations for the previously explored behaviour change theory might be the fact of PA is not solely behaviour, but a combination of behaviours (Adams and White, 2004, Brug et al., 2004), so a more complex approach considering all the aspects and factors behind PA might be needed (Adams and White, 2004). In this regard, these theories inform of some of the humans' mechanism behind behaviour, but they fail in covering the full range of possible influences, so they might exclude potentially important variables for enhancing PA among the target population (Cane et al., 2012, Michie et al., 2011). For instance, some theories such as the TPB posit intention or a similar construct as the proximal predictor of behaviour, but the empirical research shows limited relationship between the intention and the final adoption of the target behaviour (intentin-behaviour gap) (Gomes et al., 2018, Rhodes and Dickau, 2012, Sniehotta et al., 2014), while models focused on conscious/reasoned process neglect the importance of unconscious process in the adoption of a newer behaviour (Conner and Armitage, 1998, Sheeran et al., 2013, West, 2006). Moreover, these theories (SCT, TBP, SDT and TTM) usually fail to account for large amounts of variance in behaviour (Adams and White, 2004, Gourlan et al., 2016, McEachan et al., 2011, Ntoumanis et al., 2021, Rhodes et al., 2017).

On the other hand, the lack of a clear guideline to guide researcher and practitioners to design and tailor the intervention in a systematic way (Michie et al., 2011) is another aspect that needs to be considered. The literature shows that many interventions claim to be based on these theories previously analysed, but, in practice they partially or even do not apply the theory to guide and tailor the intervention (Michie and Prestwich, 2010, Prestwich et al., 2014, Romain et al., 2018). Moreover, some studies do not support the fact of interventions based on those theories are more effective to target health-related behaviours than non-theory-based interventions (Prestwich et al.,

2014, Prestwich et al., 2015). Therefore, there is a clear gap of translating the research into practice (Michie 2011). Based on these reasons and the ones provided in the previous section, newer theories and frameworks such as the Behaviour Change Wheel (BCW) (Michie et al., 2011) or the Theoretical Domains Framework (TDF) (Cane et al., 2012) have been implemented.

Among these frameworks, the BCW proposed by Michie, et al. (2011), might be a coherent approach to enhance behaviour change because it synthesizes 19 existing psychological frameworks like those described in the previous paragraph into one unique model. Moreover, contrary to the TDF, which is a model of behaviour (also the TBP, SDT, etc.), the BCW is an intervention development framework (Cane et al., 2012, Michie et al., 2014). Furthermore, it was developed to facilitate cross-disciplinary implementation of behaviour change research and practice (Michie et al., 2014, Michie et al., 2011). The main particularity of the BCW comparing to the other frameworks and models is that it aims to explain the mechanisms involved in human behaviour with a unique model (COM-B Model) made up of three principal constructs. So that, to meet with the desired behaviour (B), it is required for the person to have Capability (C), Opportunity (O), and Motivation (Michie et al., 2014, Michie et al., 2011). Furthermore, this framework highlights the need for a set of definitions for interventions and policies which are related to the COM-B Model. Thus, according to the BCW, the COM-B Model is covered a first layer of nine intervention functions and a second layer of seven Policies categories Figure 1. On the other hand, the BCW has been designed to help the intervention designer to identify the most appropriate BCTs for a given behaviour (Michie et al., 2013, Michie et al., 2011) what might help to identify those BCTs that better works for supporting inactive people to engage in more PA and to compare among different interventions and approaches (Howlett et al., 2018, Nyman et al., 2018).

Figure 1. Behavioural Change Wheel by Michie et al. (2014)

One of the strengths of the BCW is its reliability, which was calculated by comparing the inter-rater agreement of the research team with the inter-rater agreement a group of policy experts from the UK Department of Health (Michie et al., 2011). To validate this framework the 24 components of the 2010 English Government Tobacco Control Strategy (Department of Health, 2010) and the 21 components of the National Institute for Health and Clinical Excellence (NICE) Obesity Guidance were used. The inter-rated agreement resulted in 88% and 79% for the research team and 85% and 75% for the policy experts respectively (Michie et al., 2011). Despite the systematic work when developing this model and its guidelines (Michie et al., 2014, Michie et al., 2011), some researchers consider this model to be too simplistic and it neglects the impact of various psychological determinants of behaviour and lack fidelity (Ogden, 2016). Peters and Kok (2016) also acknowledge that BCW has flaws and limitations as any other existing theory. However, contrary to Ogden (2016), they suggest that the BCW can guide practitioners in promoting behaviour change, while some of the limitations of this model to conclude on effective BCTs might be overcome through research methods and conducting process evaluations. In this line, Rhodes, McEwan and Rebar (2017) suggest that the BCW are a useful framework for practitioners because it contains constructs with a strong evidence-based but, at the same time, it provides operational paths that can subdivide these constructs to particular intervention techniques.

At present, this model has been used in different health-related areas, including PA promotion or sitting time reduction with promising results for behaviour change interventions in real environments (Baker et al., 2015, Cheng et al., 2017, Gould et al., 2017, Kinnear et al., 2020, Truelove et al., 2020). However, there is still a lack of research work reporting the effectiveness of the BCW addressing PIA.

2.6. Promoting physical activity through fitness centres

2.6.1. Fitness centres as community-based centres to treat physical inactivity

In order to develop effective public health interventions, several authors suggest implementing these interventions in real-world environments (Beedie et al., 2014, Hohmann and Shear, 2002). In the physical activity case, fitness centres (fitness centres, leisure centres, studios, and other semi-structured exercise providers to adults) can be considered as community-based centres where interventions are developed to address PIA because they are the main adult's leisure-time physical activity (LPTA) providers (Deloitte and EuropeActive, 2019, IHRSA, 2018) and most adults (around 10% of European adults) use them to start, restart or engage in regular exercise (Annesi, 2003, Beedie et al., 2014, IHRSA, 2018). Furthermore, the increasing amount of fitness in the latest years makes this industry to be a major contributor to the effect to the built environment (Deloitte and EuropeActive, 2019, IHRSA, 2018), and therefore in providing opportunity to exercise to the community around fitness centres (Michie et al., 2014). In fact, in some countries like the UK around 84.5% of its population is living within a two km radius of a private or public fitness centre (LeisureDB, 2019). Thus, fitness facilities might use to increase national PA levels.

Other reason to support the use of these places as community-based centres to address PIA is that they are designed to target thousands of people with some level of individualised exercise either semi- or non-structured exercise (Beedie et al., 2016, Clavel et al., 2020, IHRSA, 2018). Whilst the available staff is trained to supervise the people while exercising and to provide them with either tips to remain healthy or with exercise programs according to their own interests and objectives (Lopez-Fernandez and Jiménez, 2018, Matić et al., 2017). Furthermore, these centres are designed to address many of the contextual factors that affect people's PA plans (e.g., safe environments; social relationship with other users, wide schedule, wide exercise opportunities [individual or collective].), what makes them be a sweet spot for large-scale public PA engagement (Clavel et al., 2020, IHRSA, 2018, Paruthi et al., 2018). Accordingly, international organizations like EuropeActive are already

developing different projects in which both the fitness industry and public health organizations work together to enhance PA among European adults (Jiménez et al., 2020).

Moreover, the technology development of these centres, especially from 2020 due to COVID-19 pandemic, make these centres to have powerful resources to target large populations (EuropeActive and Deloitte, 2020, Ingerslev Rasmus, 2021). For instance, they can now provide exercise tips, services or recommendations to their customers either in person or through online platforms (e.g., social networks, customised mobile apps, etc.) (Kercher et al., 2021). Furthermore, thanks to the improvement of CRM, mobile apps and other wearables, these centres can monitor and/or collect information about the physical activity habits of their customers (Clavel et al., 2020, Kercher et al., 2021). Finally, many of the exercise services or tips provided by these centres can be (at least partially) performed by the customer at the fitness centre, but also to be performed outdoor or at home (López, 2020). Thus, they have hundreds of different resources to support both inactive and active adult population in achieving their own personal objectives and more importantly, remaining active.

Based on these facts, delivering interventions addressing physical inactivity through fitness centres can help to reach enough people to make a real impact on the public health of a community. Furthermore, thanks to the fitness industry is a global phenomenon (Deloitte and EuropeActive, 2019, IHRSA, 2018), those intervention contents that prove to be effective to engage inactive population can be replicated in other fitness centres and countries. Accordingly, fitness industry can be a powerful allied to target different PA behaviour change objectives according to each participant's need or characteristics (i.e., achieving the international guidelines for physical activity; increasing the current physical activity levels of the person by X%; or achieving a specific exercise habit [i.e., exercising X days a week; exercising particular times each week; etc.]). Furthermore, through the payment of the membership fee, the cost of implementing, delivering and maintaining these kinds of intervention can be shared or fully covered by the person participating in the intervention or by a third agent (Lopez-Fernandez and Jiménez, 2018). So, these interventions can also be used to target low-income people (Higgerson et al., 2018) or to support behaviour change by rewarding attendance (Faulkner et al., 2019).

2.6.2. Benefits of become a fitness centre member

Under the perspective of PA promotion, the fact of being a fitness centre member might be related with positive health outcomes. However, there are still scarce evidence of the health-related

benefits of being a fitness centre member or of the capability of these centres to promote PA among their customers. In this regard, anecdotal evidence suggests that around 88% of the fitness centre members might meet the recommended 150-min of MVPA (Kaphingst et al., 2007, Schroeder et al., 2017). Also, that fitness centre members are more active than non-members counterparts (Schroeder et al., 2017). However, these studies were based on self-reported questionnaires and had a limited sample size. Thus, the prevalence of different levels of PA among fitness centre members remain unknown.

Gjestvang et al., (2019b), using accelerometers found that new members of leisure centres accounted for a lower prevalence of PIA after 12 months than the prevalence of PIA reported by the Norway population in other studies (Hansen et al., 2019, Loyen et al., 2017). However, they did not directly compare the PA levels of fitness centre members and non-fitness centre members nor considered factors like gender or age. A recent study discovered that being female or older adult were positive predictors for fitness centre-based PA (Hanson et al., 2021). Whereas Watts et al., (2017) suggested that leisure centres seem to play an important role in supporting older people to stay active. This is very important as females and older adults are usually more inactive and perform lower vigorous-PA than males or younger adults (Bauman et al., 2009, Carlson et al., 2010, Guthold et al., 2018, Mayo et al., 2019). Also, it has been reported that most new members of fitness centres were low active before enrolling in their centre (Sperandei et al., 2016). While up to 22% of ex-members of fitness centres do not engage in a PA behaviour within the following year (Gallardo et al., 2015). Also, free access to fitness in combination with outreach and marketing activities centres might reduce the PIA levels of a community (Higgerson et al., 2018). Nevertheless, further research is needed to confirm these findings.

Regarding the health-related benefits of being a fitness centre member, the evidence suggests that those members exercising at least twice a week during a period of three and twelve months is associated with an increase of cardiorespiratory fitness (I.e., maximum oxygen uptake, VO_{2max}) comparing to those who dropped out (Gjestvang et al., 2019b). However, attendance might be biased as it was self-reported, what might explain why they did not report differences in other health outcomes such as body composition, weight and maximal muscle strength among the two studied groups. On the other hand, the British Exercise Referral Scheme is using leisure centres to promote a prescribed exercise to certain population with promising results in cardiorespiratory and vascular health (Buckley et al., 2020) and in some cases in PA levels (Bell et al., 2021).

2.6.3. Challenges of the fitness industry in promoting PA

Fitness industry is one of the main leisure-time PA providers worldwide. In fact, in 2019 there were around 184 million of people enrolled in fitness centres only in Europe (IHRSA, 2020). Furthermore, since the number of fitness centres members have continuously grown since 2005 (Figure 2). Same happen with the number of fitness centre clubs which in 2019 reached the number of 63,644 clubs only in Europe in 2019 (Deloitte and EuropeActive, 2019).

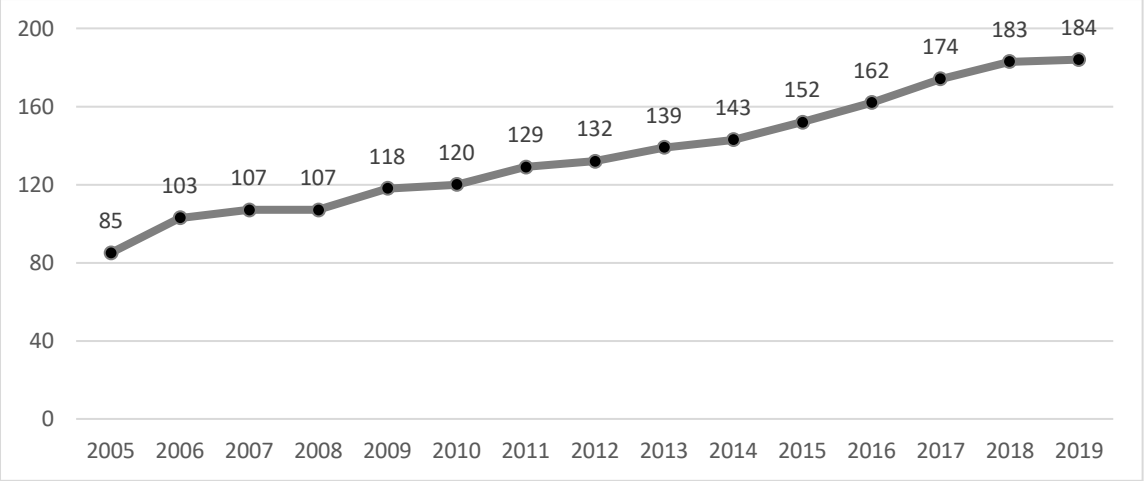

Figure 2. Evolution of fitness centres' members worldwide in millions (IHRSA, 2006, IHRSA, 2007, IHRSA, 2008, IHRSA, 2009, IHRSA, 2010, IHRSA, 2011, IHRSA, 2012, IHRSA, 2013, IHRSA, 2014, IHRSA, 2015, IHRSA, 2016, IHRSA, 2017, IHRSA, 2018, IHRSA, 2019, IHRSA, 2020)

Despite fitness centres are a major contributor to the effect to build environment regarding PA (Deloitte and EuropeActive, 2019, IHRSA, 2020), both the retention and attendance rate of these centres is relatively low (Bağci, 2017, Sperandei et al., 2019). Indeed, up to 80% of their members go to their fitness centres less than once a week (Bağci, 2017, Middelkamp et al., 2016), around 20% them do not visit the fitness centre upon becoming a member (Middelkamp et al., 2016) and, the average attendance rate oscillate between 1.1 to 5.6 exercise sessions per month (Middelkamp et al., 2016, DellaVigna and Malmendier, 2006). Thus, it is likely that many members do not exercise enough at fitness centres to meet the international guidelines for PA. On the other hand, evidence shows that retention in fitness centres is low. For instance, Sperandei et al., (2016) reported a dropout rate around 24% within the first month, 46% within the second month and 96.3% after a year. Nuviala et al., (2020) stated a dropout rate of 40.2% after four months of membership, while Sperandei et al., (2016) found that around 86% of new members drop their initial exercise intention within the first six months and most of them will not enrol again in a fitness centre in the following twelve months (Sperandei et al., 2019). Moreover, only around 2.3% of members seems to

remaining after two years' time (Middelkamp et al., 2016). Therefore, despite being designed to engage people in regular exercise, further efforts are required to retain fitness centre members and to support them in engaging in regular exercise.

At present, many works have attempted to discover the reasons for fitness centre members to dropout and the factors that might contribute to retain a customer (Clavel et al., 2020, Gallardo et al., 2018, Kinnear et al., 2020, Sperandei et al., 2019, Yi et al., 2020). However, many of these works were conducted from a marketing perspective (satisfaction levels, quality of the service and repurchase intention) (Fernández-Martínez et al., 2020, Gallardo et al., 2018, Yi et al., 2020) and did not focus on PA behaviour nor considered the fact of retaining inactive people in programs promoting PA is challenging even when they are not applied in fitness centres (Berry et al., 2018, Kuehl et al., 2016). Other studies have found that economic incentives like free membership positively contributes to local PA prevalence (Higgerson et al., 2018). However, others did not find that financial incentives increase attendance rate to fitness centres when comparing to a no-treatment control group (Carrera et al., 2018).

Fitness centres usually offer semi- and non-structured PA. This somehow might explain why only around 10% to 20% of the members perform LTPA at their fitness centre at least 2-3 times a week (Bağci, 2017, Middelkamp et al., 2016) and the high dropout rates (Middelkamp et al., 2016, Sperandei et al., 2019) as to engage in regular PA at these centres is likely to need some kind of planning and self-control (Jekauc et al., 2015, Mazzuca et al., 2017, Middelkamp et al., 2017). Moreover, the fact of the provided PA is not structured hinders the possibility of monitoring the PA pattern of the members beyond the information coming from the access point (Clavel et al., 2020) while recording the performed PA of the members outside fitness centres is a hard challenge to achieve.

The newest works in fitness centres are slightly covering this gap in literature. For instance, Kaushal, et al. (2017) studied how many days might people need go to their fitness centre to adhere in an exercise habit. Middelkamp et al. (2017) designed a behaviour change intervention using the Transtheoretical Model (Stages of Change) to support members of this centres to engage in regular exercise. However, although these works provide meaningful knowledge to the science, it is required further approaches to design effective interventions in fitness centres, either because the Transtheoretical Model did not evidence high rates of adherence (Michie et al., 2011, Middelkamp et al., 2017) or because to get the habit of exercising at a fitness centres by oneself requires the person to attend at least for four days a week (Kaushal et al., 2017).

Based on these limitations, it might be more appropriate that interventions delivered in fitness centres target the attendance rate as a formula to engage low active members in regular PA even though attendance is not necessarily equal to doing PA. This would health benefit all participants who increase their physical activity levels even if they do not achieve the recommended 150 minutes of moderate-to-vigorous PA (Mok et al., 2019) and would increase the likelihood of these people of remaining in the centre after a year (Clavel et al., 2016, Clavel et al., 2020, Yi et al., 2020). Furthermore, implementing this kind of interventions is in line to the claim of those authors who enhance using the existing community centres for "treating" inactivity (Beedie et al., 2014, Hohmann and Shear, 2002). Also, this increases the ecological validity of the intervention and provides the participants with a clear and familiar exit pathway to keep doing PA once the intervention is over (Beedie et al., 2014, National Institute for Health and Care Excellence, 2006, Pavey et al., 2011).

2.6.4. Factors influencing attendance behaviour at fitness centres

The existing evidence show that attendance behaviours is affected by multiple factors. However, these factors might be categorised into the six components of the COM-B Model: Physical Capability; Psychological Capability; Reflective Motivation; Automatic Motivation; Social Opportunity; Physical Opportunity (Michie et al., 2014). Below, a brief analysis of the main factors affecting the attendance behaviour is described, dividing these factors into the COM-B Model constructs:

2.5.4.1. Physical Capability

Having the physical capability to partake in PA is a primary condition to change to active behaviour. However, within this fact there are some factors that might be relevant in people to exercise in fitness centres. For instance, those individuals who reported never engaged in PA before usually show a short membership length (Sperandei et al., 2016). Thus, having a low physical fitness might be a key factor in enrolling and regular visiting fitness centres. In this regard, members with low physical health visit their leisure centre less frequently than healthy individuals regardless of their age and gender and are very likely to dropout within the first year of membership (Hooker et al., 2016). Moreover, overweight members seem to be less likely to self-report meeting the recommended 150-min of MVPA within at the short time than non-overweight members (Kaphingst et al., 2007). Although it might not be a significant factor to explain dropout from these centres (Garay et al., 2014).

2.5.4.2. Psychological Capability

The individual's perception of ability to attend a fitness centre or to exercise there has been identified as a key aspect for a person to regularly exercise there (Jekauc et al., 2015, Middelkamp et al., 2016, Sperandei et al., 2016, Brown et al., 2017). Furthermore, the perceived behavioural control might also be a key aspect in regular attendance to this kind of places (Jekauc et al., 2015). In fact, new members with no previous experience in fitness centre might have a great need for staff empathy and help (MacIntosh and Law, 2015, Marandi and Harris, 2010). Whereas no previous PA experience is a factor for early dropout (Sperandei et al., 2016). On the other hand, the UK Referral Scheme Program provides the people with a clear exercise program to follow at the fitness centres so knowing what exercise do at fitness centres might positively contribute to attend places to exercise (Bell et al., 2021, Buckley et al., 2020). Furthermore, a lack of providing people with an appropriately designed program might contribute to a member lose (Hanlon and Coleman, 2006). Nonetheless, there is not much evidence on this regard.

2.5.4.3. Reflective Motivation

The reflective motivation is another key factor for people to enrol, exercise and leave a fitness centre. Body image is one of these factors even when BMI might not BMI might not explain the attendance rate (Caudwell and Keatley, 2016). For instance, men who perceived high body fat might report higher attendance frequency (Caudwell and Keatley, 2016), while poor body satisfaction is frequently described by women as a barrier to exercise in fitness centres (Pridgeon and Grogan, 2012). Moreover, those people motivated in improving and maintaining the physical appearance report higher rates of visit frequency (Riseth et al., 2019, Springer et al., 2013). Further evidence suggests that the feeling of controlling and perceiving body changes positively affect the individuals' commitment to attend fitness centres (Mullen and Whaley, 2010). Although this fact is more frequently in young adults and women (Mullen and Whaley, 2010). Nevertheless, surprisingly, repeated physical testing did not resulted in higher attendance rate in fitness centres (Gjestvang et al., 2021)

Achieving health benefits is another key determinant to be considered. This is because health-related benefits is one the main reasons to enrol and remain in fitness centres (MacIntosh and Law, 2015, Riseth et al., 2019, Springer et al., 2013). Further, long-term members highlight that health-benefits like having ore energy, reducing stress, or improving mood and sleep wellbeing are main reasons for them to keep exercising in fitness centres (Riseth et al., 2019, Springer et al., 2013). Also, people suffering from health condition emphasize that PA help them to manage pain and to

prevent their health from deteriorating (Riseth et al., 2019). Thus, having goals to achieve by exercising is important for people to engage in exercise at fitness centres, although some people might not meet their initial exercise intention (Muller and Habla, 2018). Factors like booking classes in advance or reminding emails might help to increase attendance and support people to meet with their initial exercise intentions (Muller and Habla, 2018)

Social comparison is another factor that might play a significant role for adults to exercise in fitness centres as regular exercisers affirm to felt motivated by comparing their progress and abilities to other regular fitness centres members (Pridgeon and Grogan, 2012). However, the intention to become a member before the opening of a leisure centre, subjective norms, anticipated regret, or attitudes did not resulted in self-reported attendance frequency (Schwetschenau et al., 2008, Smith et al., 2019).

On the other hand, the membership fee has been found one of the main reasons for ex-fitness centre members to drop out (Clavel et al., 2016, Gallardo et al., 2018) while value for money and other factors related to perceive quality have resulted to be determinants to remain in fitness centres (Matić et al., 2017, Gallardo et al., 2018, MacIntosh and Law, 2015). Financial incentives like free membership fee might positively increase the PA levels of a community (Faulkner et al., 2019, Higgerson et al., 2018) whereas payment of no-show fees might increase attendance commitment and support people to becoming regularly active (Riseth et al., 2019). However, Carrera et al., (2018) reported that financially incentivising attendance did not result in the habitual use of the facility in new members.

2.5.4.4. Automatic Motivation:

Automatic Motivation is very related to different feelings people might experience when performing a specific behaviour. In the case of exercising at fitness centre, having a routing that makes non-adheres feeling more confident and empowered might play a key role for them to exercise at fitness centres and remain as a customer (Mullen and Whaley, 2010). In addition, enjoyment, the feelings of belonging and acceptance or exercising in a non-stigmatising atmosphere seems to affect attendance to fitness centres (Carron and Burke, 2005, Coen et al., 2018, Fisher et al., 2018, Withall et al., 2011). In this regard, some authors have suggested that fitness centres are not as friendly spaces due to the existence of some gender norms that might cause gender segregation and people not to invade the other gender's space (Coen et al., 2018, Fisher et al., 2018). On the other hand, high levels of social interaction, interest, and enjoyment are all associated

with improved levels of retention (Withall et al., 2011), while friendly competition with other fitness centre members might reinforce some peoples' identity, self-esteem and generate a feeling of acceptance and belonging (Pridgeon and Grogan, 2012).

2.5.4.5. Physical opportunity:

Physical opportunity often refers to an individual's actual environment that somehow may limit or enhance the possibility of adopting or performing a particular behaviour (Michie et al., 2014). The wide schedule of fitness centres might be positive factor for many people to exercise there (MacIntosh and Law, 2015). Same happen with the broad exercise offer, service quality and convenience (Coen et al., 2018, Gallardo et al., 2018, MacIntosh and Law, 2015, Mullen and Whaley, 2010), although extra amenities and training aids might not be very important factors for people to exercise (Mullen and Whaley, 2010). However, the possibility of booking class in advance might works as a commitment with future exercise and therefore, positively increase attendance (Muller and Habla, 2018). Staff is also important part of the physical environment of fitness centres. In fact, staff support and the way they interact with fitness centre members has been identified as a key factor for members' satisfaction (MacIntosh and Law, 2015, Nuviala et al., 2013). In fact, new members with no previous experience in fitness centre might need further staff support (MacIntosh and Law, 2015, Marandi and Harris, 2010). Furthermore, personal trainers and other staff members are important in customer retention, attendance and enjoyment (Matić et al., 2017, Wayment and McDonald, 2017).

On the other hand, the available time for exercising is one of the main reasons for people to dropout and to attend to these places to exercise (Gallardo et al., 2018, Lenhart, 2019, Mullen and Whaley, 2010), although Schwetschenau et al. (2008) reported that perceived time barriers do not influence self-reported attendance. The membership cost has been frequently identified as a primary reason for leaving a fitness centre (Nuviala et al., 2013). Also, the membership characteristics and membership renewal period might influence dropouts (Clavel et al., 2020, DellaVigna and Malmendier, 2006). For instance, members with a monthly rolling contract are more likely to remain for more than a year compared to members on a year-long fixed-term contract (DellaVigna and Malmendier, 2006). Factors like holidays seems to decrease the attendance rate (Fredslund and Leppin, 2019). But the main issue is that after holidays like aster the attendance rate might not to reverse to prior Easter values and be followed by a steady further decline in the subsequent weeks (Fredslund and Leppin, 2019).

2.5.4.6. Social opportunity:

Social support from different groups might be also an important factor for people to exercise in fitness centres. In this regard, exercising with a partner has been associated with a higher exercise adherence (Cholewa et al., 2008). Also, having a social network at the fitness centres has been identify as an important factor to maintain motivation (MacIntosh and Law, 2015). Indeed, high levels of social interaction, perceptions of social support and individual support seems to improve customer retention (Raine et al., 2002, Withall et al., 2011). Nevertheless, it is important to highlight that fitness centres are frequently described as "hyper-masculine" with specific social norms that might be a barrier for both some males and females to exercise there (Coen et al., 2018, Mullen and Whaley, 2010)

Group classes in fitness centres might be a positive way to engage people (Crossley, 2006), although closed groups like crossfit might provide higher adherence and belonging feeling (Fisher et al., 2016). Nonetheless, it is important to consider that negative emotions such as embarrassment to exercise in front of others decrease attendance frequency (Schwetschenau et al., 2008). Social interaction from fitness centre staff is also important for many people to exercise (Matić et al., 2017). Further, tailored support from fitness professionals increases their feelings of individualism and self-direction (Springer et al., 2013)

2.7. Ontology and epistemological approach

In this thesis, the author adopted a critical realist approach (Bhaskar, 1975). This is because he assumed that the studied phenomenon (in this case the mechanism of changes in humans) has both a transitive and intransitive dimension (Al-Amoudi and Willmott, 2011, Michie et al., 2014, Yucel, 2018). Based on this, the author adopted ontological realism as he acknowledges the existence of a mind-independent, structured, and changing reality (Bhaskar, 1975). However, he also recognises that knowledge is a social product, which is not independent of those who produce it (Bhaskar, 1975). Therefore, he embraced epistemological relativism, accepting that a complete truth cannot be achieved (Collier, 1994, Yucel, 2018). According to this position, the researcher understands that truth is relative to context, it might be competing and contradictory theories, and some knowledge cannot be fully achieved. But some theories might be more accurate and lead to more precise interventions (Bhaskar, 1975, Collier, 1994, Yucel, 2018). This position aligns with the fact of existing behaviour change theories do not fully explain the mechanism of change and only partially support the behaviour change, but some frameworks or models seem better to inform the

mechanisms and guide to more effective actions (Michie et al., 2014). Finally, the selection of critical realism permits the researcher to use hypothetical-deductive reasoning to propose a hypothesis and test them through observational data, but also use inductive reasoning to infer whether the observational data supports the existence of phenomena and events (Guba and Lincoln, 1994, Moon and Blackman, 2014, Yucel, 2018). Therefore, increasing knowledge can be achieved through a mixture methods (Guba and Lincoln, 1994, Moon and Blackman, 2014).

Chapter 3

A comparative analysis of reported physical activity from leisure centres' members vs. the general population in Spain

This is the first empirical chapter of this Doctoral Research. Through this chapter it is aimed to address the following research questions: What is the prevalence of PIA, Moderate-PA, and High-PA among fitness centre members? Does the prevalence of PIA, Moderate-PA and High-PA differ between fitness centres members and the general population? Are there differences among the prevalence of PIA, Moderate-PA, and High-PA according to gender and age? What is the origin of the PA conducted by both fitness centres' members and the general population? What are the PA patterns of both fitness centres' members and the general population according to their PA levels? A version of this chapter has been published by the BMJ Open in 2021.

This work was conceived for this Doctoral Research by the PhD student. However, it was developed with the collaboration of other authors. Besides conceiving the research, the PhD student actively participated in the development of all the research phases. Accordingly, He defined the methodology followed in this research. He cleaned the two datasets, merged both into the unique database and conducted the statistical analysis. He participated in the revision and validation of the data analysis and drafted the manuscript. Finally, he critically reviewed the drafted versions until the final version was achieved. The PhD student did not coordinate the different stages of the research as the coordination responsibility was assumed by other authors with more experience. However, the PhD student took part in all the decision-making processes.

This is the full reference to the published version: López Fernández, Jorge, López-Valenciano, Alejandro, Mayo, Xián, Horton, Elizabeth, Clavel, Ivan, Liguori, Gary, & Jiménez, Alfonso. (2021). Comparative analysis of reported physical activity from leisure centres' members versus the general population in Spain. BMJ Open, 11(6), e043963. doi: 10.1136/bmjopen-2020-04396. Access to this manuscript is free as it has been open access published and a copy can be found in Appendix 1.

3.1. Abstract and Keywords

There is few information about the physical activity levels of members of fitness centres and if they are more active that non-fitness centres. Therefore, this chapter aimed 1) to describe the PA levels of the members of a Spanish leisure centre operator according to age and gender; 2) to describe the differences in the three PA levels between the members of a Spanish leisure centre operator and the general Spanish population considering the PA Eurobarometer data according to their gender and age; and 3) to explore the intensity-origin of the PA either in Spanish members of leisure centres or the Spanish population considering their gender. A descriptive epidemiology study design was used. Data from 16 Spanish leisure centres (n = 3,627) and from the 2017 Eurobarometer 472 for Spain (n = 1,002) were used for this research. The PA levels were analysed with the International Physical Activity Questionnaire short version, and respondents were grouped into physical inactivity (PIA), Moderate-PA, and High-PA. Moreover, gender (men or women) and age (18-29 years; 30-44 years; 45-59 years; 60-69 years; ≥70 years) were considered. Total MET-minutes/week, as well as total MET-minutes/week for walking-intensity, moderate-intensity, and vigorous-intensity were recorded. Leisure centres showed a lower prevalence of PIA and a higher prevalence of High-PA than the general population ($p < 0.05$). Women displayed a higher prevalence of PIA and lower prevalence of High-PA than men ($p < 0.05$). The prevalence of PIA increases with age while the prevalence of High-PA decreases. Leisure centres engage most of their members in regular PA, including women and older adults, and these members also perform a higher number of MET in vigorous PA, than the general population.

Keywords: Fitness centres; Gym; Physical activity; Physical inactivity.

3.2. Introduction

Physical inactivity (PIA) is defined as the default of the weekly Global Recommendations on physical activity (PA) (World Health Organization, 2020). It is different to sedentary behaviour which represents those behaviours performed in sitting or lying position with a low level of energy expenditure (≤1.5 METs) (Tremblay et al., 2017). The Global Recommendation of PA differ across different age groups (i.e., children and adults). Thus, according to the 2020 guidelines, PIA in adults means failing to accumulate 150 minutes of moderate-to-vigorous aerobic PA throughout the week (< 600 metabolic equivalent minutes [MET minutes]) (Bull et al., 2020). This situation is one of the main risk factors for developing of non-communicable diseases and premature death in adults, so it has become a global public health issue (Lee et al., 2012, Stamatakis and Bull, 2020). In Spain, like in

other European countries, this issue is not an exception, as the lack of sufficient physical activity or PIA accounted for 9.3% of coronary heart disease, 10.3% of type 2 diabetes, 13.8% of breast cancer, 14.9% of colon cancer, and 13.4% of all-cause mortality during 2012. At the same time, life expectancy would increase by 0.78 years if PIA was eliminated (Lee et al., 2012). Moreover, healthcare expenditure attributed by PIA in Spain has been quantified in Int$2.024 billion of direct cost, Int$1.425 billion costs for the public sector and Int$461.6 million costs for households (Ding et al., 2016). Thus, reducing the impact of PIA in people's lives, and in public healthcare systems, will bring considerable public health benefits, but remains one of the current challenges for policymakers (EU Working Group "Sport and Health, 2008, World Health Organization, 2018a).

The Global Action Plans in 2013 and 2018 challenges the countries to increase their prevalence of PA by at least 10% of 2010 baseline data by 2025 and 15% of 2016 baseline data by 2030 (World Health Organization, 2013, World Health Organization, 2018a). However, the levels of PA have diminished in Europe within the last 15 years (Mayo et al., 2018, Mayo et al., 2019), the same as Spain, where the levels of PA have decreased significantly between 2013 and 2017 in men and women, thereby nullifying the objectives set by the Global Action Plans (Mayo et al., 2019, World Health Organization, 2013, World Health Organization, 2018a).

The socio-ecological approach as well as the Global Action Plan, suggest that to effectively address PIA it is required to promote different domains of PA: i.e., occupational, travel, home, or leisure-time (Glass and McAtee, 2006, World Health Organization, 2018a). Within these domains, leisure-time PA (LTPA) has resulted effective to reduce the cardiovascular risk in the general population (Byambasukh et al., 2020) and to improve other health parameters in older adults (i.e., body composition, muscle strength or sarcopenia) (Rosique-Esteban et al., 2019). Moreover, LTPA reduces the risk of premature death regardless of pre-existing health conditions (Liu et al., 2018). Since recreational facilities such as leisure centres are one of the main LTPA providers for adults (Deloitte and EuropeActive, 2019), it might be a good strategy to promote these places to address PIA (Beedie et al., 2014, Lopez-Fernandez and Jiménez, 2018) and combine this approach with further strategies to promote PA in other domains (Glass and McAtee, 2006). This view aligns with the authors of the latest Global Action Plan as they encourage policymakers to strengthen and enhance the fitness sector together with other sectors (Action 1.4 and Action 3.3) and combine them with other domains of PA (World Health Organization, 2018b).

Focusing on leisure centres as a key source to promote PA is advisable, as they are specifically designed to engage people in regular LTPA (Beedie et al., 2014, Lopez-Fernandez and

Jiménez, 2018), and enjoyed daily by thousands of people, who start, restart, or continue with a PA habit (Annesi, 2003, IHRSA, 2018). In Spain, for instance, around 5.3 million people (≈11.4% of the adult population) are enrolled in a leisure centre. In addition, these centres are designed to address many of the contextual factors that affect people's PA plans (e.g., safe environments; social relationship with other users, wide schedule, wide exercise opportunities [individual or collective], etc.), what makes them be a sweet spot for large-scale public PA engagement (Clavel et al., 2020, IHRSA, 2018, Paruthi et al., 2018).

Despite these factors, the capability of these centres to promote PA is unknown as it is the percentage of members who can be considered active. Thus, care must be taken when suggesting these centres for promoting PA. The common sense and the anecdotal evidence might suggest that most of the leisure centre members are adequately active when analysing self-reported PA (Kaphingst et al., 2007, Schroeder et al., 2017), and they are more active than non-members counterparts (Schroeder et al., 2017). Nevertheless, the lack of normative values and comparisons with the general population according to the gender and ages do not allow to conclude these facts.

On the other hand, PIA is age-related, with older adults exercising for significantly less time and at lower intensities than younger individuals (Bauman et al., 2009, Carlson et al., 2010). It is also gender-related as a higher proportion of women do not engage in sufficient PA and active women accumulate less weekly MET and perform less time of vigorous exercise than men (Guthold et al., 2018, Mayo et al., 2018, Mayo et al., 2019). Leisure centres seem to reduce this gap because around half of the members of these centres are women (Clavel et al., 2020, IHRSA, 2018). Also, they have been proved to be useful in increasing the PA levels and intensity of older adults (Watts et al., 2017). However, the prevalence pattern of PA among women and elderly members of leisure centres is still unknown. Thus, the objectives of this study were 1) to describe the PA levels of the members of a Spanish leisure centre operator according to gender and age; 2) to describe the differences in the three PA levels between the members of a Spanish leisure centre operator and the general Spanish population considering the PA Eurobarometer data according to their gender and age; 3) to explore the intensity-origin of the PA either in Spanish members of leisure centres or the Spanish population considering their gender.

It is expected that this work provides normative values about the prevalence of PA in leisure centres according to the age and gender what might help to understand the effectiveness of these places for promoting PA. Moreover, since the World Health Organization (WHO) is encouraging the policymakers to strengthen the leisure centres in order to improve PA levels of modern societies

(World Health Organization, 2018a), the findings from this work might help to set the role of leisure centres to address PIA in different populations.

3.3. Materials and Methods

3.3.1. Ethical approval

Ethical approval for this study was not applied because Eurobarometer 472 database has been published by the European Commission and, it is public access. In addition, the Go fit database was provided by a Spanish leisure centres operator (GO fit-Ingesport Health & Spa Consulting SA) that periodically survey its customers about their current PA levels and service satisfaction. Customers were informed that the conducted survey could be used to conduct market studies and research studies. No personal data or data that could be used to identify a person was included in GO fit database provided by Ingesport. Researchers did not participate in the survey or guide it.

3.3.2. Study design and data sources

This is a descriptive epidemiology study. The data used in this study come from two different databases. The first one is the 2018 GO fit Observatory raw data, which was provided by a Spanish leisure centres operator (GO fit-Ingesport Health & Spa Consulting SA) that periodically survey its customers about their current PA and service satisfaction. This survey was conducted via online between January and June of 2018. The sample inquired comes from 16 fitness & leisure centres (n = 3,627), which are spread in seven of the seventeen Spanish Regions (Andalucía, Cantabria, Castilla y León, Castilla-La Mancha, Comunidad de Madrid, Gran Canarias and Principado de Asturias). The survey used a stratified random design based on the number of members per centre, their gender, and their age. All leisure centres were operated by a private organization and were equipped by an indoor swimming pool, several spaces for collective classes, and a fitness room. All centres offered different sort of exercise services including individualised exercise programs and collective classes (e.g., endurance, dancing, jumping, wellbeing, etc.) and nutritional services. The second database comes from the 2017 Special Eurobarometer 472 (European Opinion Research Group, 2018), a public opinion surveys that the European Commission simultaneously conducts on all the EU state members to understand the levels of PA and sports participation of each country's population. In this case, data were obtained from the adult Spain population (n = 1,002) a few months before GO fit-Ingesport conducted their 2018 Observatory survey. The Eurobarometer surveys are conducted under a multi-stage sampling, random design. In order to cover the whole territory of the country,

the number of sampling points are drawn with probability proportional to both population size and population density. To this purpose, the age, gender, region, and the size of the locality are introduced in the iteration procedures (European Opinion Research Group, 2018).

3.3.3. Measurements

Both data sources used the short form of the International Physical Activity Questionnaire (IPAQ), which is used to inquire about the levels of PA (International Physical Activity Questionnaire, 2005). This instrument measures the intensity, frequency, and duration of PA performed within the previous seven days by examining the number of days performing vigorous, moderate, and walking PA and the total minutes during those days (International Physical Activity Questionnaire, 2005). The 2018 GO fit Observatory used an online version of the short form of the IPAQ with the classical open solution as responses were not truncated. On the contrary, the Special Eurobarometer 472 survey used a modified version of the IPAQ with responses truncated to five different fixed possibilities, instead of the classical open solution, to indicate the minutes performed in each activity (European Opinion Research Group, 2018, International Physical Activity Questionnaire, 2005). In order to reduce the bias due to the approach differences between databases both sources, the responses from the GO fit Observatory were truncated according to the methodology used in the Special Eurobarometer 472. Thus, for the case of PA, in both cases a response of “30 minutes or less” was assumed to mean 15 min, a response of “31 to 60 minutes” was assumed to mean 45 min, a response of “61 to 90 minutes” was assumed to mean 75 min, a response of “91 to 120 minutes” was assumed to mean 105 min, and a response of “more than 120 minutes” was assumed to mean 120 min (Gerovasili et al., 2015).

The data processing and analysis were completed using a modified ad hoc spreadsheet available online (Cheng, 2016) according to the instruction for data processing and analysis of the IPAQ short form (International Physical Activity Questionnaire, 2005) and the methodology used in recent studies (Mayo et al., 2018, Mayo et al., 2019). Only individuals with at least one valid intensity and duration of a particular intensity (i.e., both variables with a different answer than “don’t know”) were analysed. In this regard, “Moderate-PA” was considered when reporting (a) at least 3 days of vigorous intensity activity of at least 20 min per day; (b) at least 5 days of moderate intensity activities and/or walking for at least 30 min per day; or (c) at least 5 days combining the intensities mentioned above achieving at least 600 MET-minutes/week. “High-PA” was considered when reporting (d) 3 or more days of vigorous-intensity activity of at least 20 minutes per day; or (e) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day MET-

minutes/week. “Low-PA” (Inactive or PIA) was considered if not meeting any of these thresholds (International Physical Activity Questionnaire, 2005). Moreover, Moderate-PA and High-PA were considered as active. The metabolic equivalents (MET) of the respondents were calculated accordingly to the existing guidelines so that walking-, moderate-, and vigorous-intensity accounted for 3.3, 4.0, and 8.0 METs, respectively (International Physical Activity Questionnaire, 2005). Thus, walking, moderate, and vigorous MET-minutes/week were calculated by multiplying the selected MET value by the minutes and days of each intensity. The total PA MET-minutes/week was obtained by summing up the walking, moderate and vigorous MET-minutes/week score. On the other hand, in order to explore the origin of the MET-minutes/week for the three groups of PA analysed (Low-PA, Moderate-PA and High-PA) the average MET-minutes/week for walking, moderate and vigorous PA and total average MET-minutes/week in each group were calculated. Using these values, the proportion (%) of MET-minutes/week coming from walking, moderate, and vigorous activities was also estimated.

3.3.4. Statistical Analysis

For the analysis of PA prevalence levels (Low-PA, Moderate-PA, and High-PA), data were displayed as a proportion (%) with 95% confidence intervals (95%CI). In this regard, analysis between the leisure centres and the Eurobarometer were analysed with a $\chi 2$ test for the overall sample and separately by gender and age groups (18-29 years, 30-44 years, 45-59 years, 60-69 years and ≥70 years). Z-Score for two population proportions was used for this purpose. A $\chi 2$ test for the overall sample and separately by the gender and age was also used to compare the origin of the MET-minutes/week for the three PA groups (Low-PA, Moderate-PA, and High-PA) between members from the leisure centres and people from the Eurobarometer. Once again, Z-Score for two population proportions was used for this purpose. These tests were conducted using Microsoft 365 Excel Version 2003 (Build 12624.20320; Microsoft Corporation; Redmond, Washington, United States of America). On the other hand, the differences in total MET-minutes/week between leisure centres and Eurobarometer, also considering gender, were analysed by a two-way ANOVA. To this purpose, linearity, skewness, and asymmetry were considered. These analyses were conducted using the Statistical Package for Social Sciences (version 22.0, SPSS Inc., Chicago, IL, USA). The level of significance was established at 0.05.

3.4. Results

Demographic data from the participants in both leisure centres' survey and Eurobarometer survey are displayed in Table 1. In both databases, slightly more women were recruited than men. Moreover, members of leisure centres were younger than those representing the Spanish population (-8.68 years).

Table 1. Participants' demographic characteristics

Database	# Women	% Women	# Men	% Men	Age*
GO fit-Ingesport operated leisure centre (GO fit Observatory)	1898	52.3%	1729	47.7%	42.67±12.05
Spanish general population (Special Eurobarometer 472)	555	55.4%	447	44.6%	51.35±18.20

*** Age**: expressed as mean ± standard deviation

As can be identified in Table 2, significant differences were found in the three levels of PA between leisure centres and the general Spanish population. In this regard, the percentage of Low-PA population was significantly higher in the general Spanish population either for the whole sample or for women and men separately ($p < 0.001$). The prevalence of Moderate-PA was also higher in the general Spanish population either for the whole sample, and women and men separately ($p < 0.001$). On the contrary, the GO fit-Ingesport operated leisure centres showed a higher prevalence of High-PA for the whole sample and for women and men separately. Considering gender, women showed a higher Low-PA and a lower High-PA prevalence in comparison with men in both samples ($p < 0.001$-0.015 respectively). Considering the age of the samples, similar findings were reported as to the total population in which the Low-PA population were descriptively increasing with the age brackets and high-PA levels being reduced with every new age bracket.

Table 2. Prevalence (expressed as percentage) of Low-, Moderate-, and High PA adults between the GO fit-Ingesport operated leisure centre members and the general Spanish population.

	GO fit-Ingesport operated leisure centre (GO fit Observatory)							Spanish general population (Special Eurobarometer 472)							GO fit-Ingesport operated leisure centre – Spanish General population					
	n	Low-PA (PIA)		Moderate-PA		High-PA		n	Low-PA (PIA)		Moderate-PA		High-PA		Low-PA (PIA)		Moderate-PA		High-PA	
		%	95% CI	%	95% CI	%	95% CI		%	95% CI	%	95% CI	%	95% CI	Z-Score	p-Value	Z-Score	p-Value	Z-Score	p-Value
All sample	3627	15.5%	14.3%-16.8%	37.4%	36.0%-39.0%	47.0%	45.4%-48.7%	1002	34.0%	31.1%-36.9%	48.3%	45.2%-51.2%	17.7%	15.3%-20.1%	13.08	<0.001 ƛ	6.22	<0.001 ƛ	16.75	<0.001 ‡
Women	1898	18.6%	16.9%-20.3%	41.3%	39.2%-43.6%	40.0%	37.8%-42.3%	555	37.3%	33.2%-41.3%	49.7%	45.7%-54.1%	13.0%	10.1%-16.0%	9.23	<0.001 ƛ	3.50	<0.001 ƛ	11.85	<0.001 ‡
Men	1729	12.1%	10.6%-13.7%	33.1%	30.9%-35.4%	54.7%	52.5%-57.2%	447	30.0%	25.8%-34.1%	46.5%	42.0%-51.3%	23.5%	19.6%-27.6%	9.21	<0.001 ƛ	5.26	<0.001 ƛ	11.78	<0.001 ‡
Z-Score		5.36		5.11		8.84			2.43		1.01		4.34							
P-Value		<0.001#		<0.001&		<0.001#			0.015#		0.314		<0.001#							
Age																				
18-29 years	535	9.5%	7.1% - 12.1%	30.7%	26.6% - 34.6%	59.8%	55.9% - 64.2%	147	19.7%	13.2% - 26.1%	55.8%	48.0% - 64.0%	24.5%	17.4% - 31.3%	3.40	0.001 ƛ	5.62	<0.001 ƛ	7.59	<0.001 ‡
30-44 years	1562	15.2%	13.6% - 17.0%	37.8%	35.5% - 40.1%	46.9%	44.6% - 49.5%	234	33.3%	27.0% - 39.6%	49.1%	42.7% - 56.1%	17.5%	12.8% - 22.4%	6.78	<0.001 ƛ	3.30	0.001 ƛ	8.47	<0.001 ‡
45-59 years	1188	17.0%	14.9% - 19.3%	38.6%	35.9% - 41.4%	44.4%	41.7% - 47.0%	264	33.3%	27.8% - 38.9%	47.7%	42.0% - 53.8%	18.9%	14.3% - 23.9%	6.00	<0.001 ƛ	2.72	0.006 ƛ	7.63	<0.001 ‡
60-69 years	279	20.1%	15.8% - 25.3%	40.1%	34.2% - 46.0%	39.8%	33.8% - 45.7%	159	34.6%	27.1% - 41.8%	45.9%	38.1% - 54.1%	19.5%	13.6% - 26.1%	3.36	0.001 ƛ	1.28	0.240	8.49	<0.001 ‡
≥70 years	63	25.4%	14.5% - 36.0%	50.8%	37.9% - 62.5%	23.8%	14.0% - 34.8%	198	46.0%	38.7% - 52.8%	44.4%	37.9% - 51.3%	9.6%	5.7% - 13.9%	2.89	<0.004 ƛ	0.88	0.378	2.92	0.004 ‡

‡ Significantly higher prevalence (p<0.05) in the Leisure Centres compared to the Eurobarometer.
ƛ Significantly higher prevalence (p<0.05) in Eurobarometer compared to the Leisure Centres.
Significantly higher prevalence (p<0.05) in women compared to the men.
& Significantly higher prevalence (p<0.05) in men compared to the women.
Low-PA (PIA): Low active according to the guidelines of the IPAQ short version questionnaire. This group is considered as physical inactive (PIA).
Moderate-PA = Moderate active according to the guidelines of the IPAQ short version questionnaire.
High-PA = High active according to the guidelines of the IPAQ short version questionnaire.

Table 3 shows the origin of the MET-minutes/week for the three PA groups (Low-PA, Moderate-PA, and High-PA). The Low-PA population and population with Moderate-PA levels from GO fit-Ingesport operated leisure centres showed a higher proportion of METs coming from vigorous-intensity and a lower proportion of METs coming from walking than the Spanish population, despite having similar %METs of moderate-intensity. This was confirmed for the whole sample and considering the gender subs-samples, except for women in the Moderate-PA levels, in which GO fit-Ingesport members also had higher levels of moderate intensity METs than the Spanish population. In High-PA population, there were no differences in the %METs walking between sample. However, GO fit-Ingesport members reported higher %METs of vigorous activity and lower %MET of moderate activity in comparison with the general Spanish population.

Table 3. Origin of the MET-minutes/week in the three PA intensity (Low-PA, Moderate-PA, and High-PA) either for Leisure Centres or Eurobarometer

		GO fit- Ingesport operated leisure centre (GO fit Observatory)			Spanish general population (Special Eurobarometer 472)			GO fit-Ingesport operated leisure centre – Spanish General population					
		%METs Walking Intensity	%METs Moderate Intensity	%METs Vigorous Intensity	%METs Walking Intensity	%METs Moderate Intensity	%METs Vigorous Intensity	%METs Walking Intensity		%METs Moderate Intensity		%METs Vigorous Intensity	
								Z-Score	*p-Value*	*Z-Score*	*p-Value*	*Z-Score*	*p-Value*
	All sample	43.7%	11.9%	44.5%	73.2%	12.8%	14.0%	7.88	<0.001 ƛ	0.36	0.717	8.61	<0.001 ‡
	Women	52.5%	10.4%	37.2%	81.6%	12.7%	5.8%	7.43	<0.001 ƛ	0.92	0.355	8.74	<0.001 ‡
Low-PA	Men	32.1%	13.9%	54.0%	64.7%	12.8%	22.5%	9.81	<0.001 ƛ	0.45	0.652	9.49	<0.001 ‡
	Z-Score	7.02	1.81	5.72	4.31	0.05	5.29						
	P-Value	<0.001#	0.070	<0.001&	<0.001#	0.960	<0.001&						
	All sample	52.0%	14.7%	33.3%	74.0%	13.8%	12.2%	13.02	<0.001 ƛ	0.75	0.452	14.29	<0.001 ‡
	Men	47.0%	15.0%	38.0%	67.2%	16.5%	16.3%	11.84	<0.001 ƛ	1.27	0.205	14.11	<0.001 ‡
Moderate -PA	Women	55.8%	14.6%	29.6%	79.3%	11.7%	9.0%	14.20	<0.001 ƛ	2.41	0.016 ‡	12.49	<0.001 ‡
	Z-Score	5.26	0.33	5.31	7.60	3.87	6.07						
	P-Value	<0.001#	0.739	<0.001&	<0.001#	<0.001&	<0.001&						
	All sample	25.3%	17.2%	57.5%	25.2%	26.0%	48.8%	0.21	0.837	13.32	<0.001 ƛ	29.82	<0.001 ‡
	Men	23.3%	16.6%	60.1%	24.2%	25.0%	50.8%	1.15	0.255	10.56	<0.001 ƛ	9.64	<0.001 ‡
High-PA	Women	28.0%	17.9%	54.1%	26.8%	27.8%	45.5%	1.32	0.188	11.43	<0.001 ƛ	8.43	<0.001 ‡
	Z-Score	5.29	1.72	5.98	2.98	3.23	5.44						
	P-Value	<0.001#	0.085	<0.001&	0.003#	0.001#	<0.001&						

‡ Significantly higher prevalence (p<0.05) in the Leisure Centres compared to the Eurobarometer.
ƛ Significantly higher prevalence (p<0.05) in Eurobarometer compared to the Leisure Centres.
Significantly higher prevalence (p<0.05) in women compared to the men.
& Significantly higher prevalence (p<0.05) in men compared to the women.
Low-PA: Low active according to the guidelines of the IPAQ short version questionnaire. This group is considered as physical inactive (PIA).
Moderate PA = Moderate active according to the guidelines of the IPAQ short version questionnaire.
High PA = High active according to the guidelines of the IPAQ short version questionnaire.

Considering gender, there were differences between women and men for all levels and intensities except for the %METs at moderate-intensity in the GO fit-Ingesport sample and for the Low-PA group of the Spanish population regarding %MET at moderate-intensity ($p > 0.05$). In this regard, in both samples and in the three levels of intensity, women had a higher percentage of METs coming from walking and a lower percentage of METs coming from vigorous intensity ($p < 0.005$).

Finally, the total MET-minutes/week achieved by both samples are displayed in Figure 3. Despite no interaction effect between gender and sample was found, the total MET-minutes/week of GO fit-Ingesport centre members were significantly higher than the general Spanish population (3051.59 METs vs 1784.52 METs; $p < 0.001$). The same was reported for both women (2732.16 METs vs 1461.07 METs; $p < 0.001$) and men (3402.26 METs vs 2186.12 METs; $p < 0.001$). On the other hand, women showed a lower total MET minutes/week in both the sample from leisure centres and the Spanish population ($p < 0.001$).

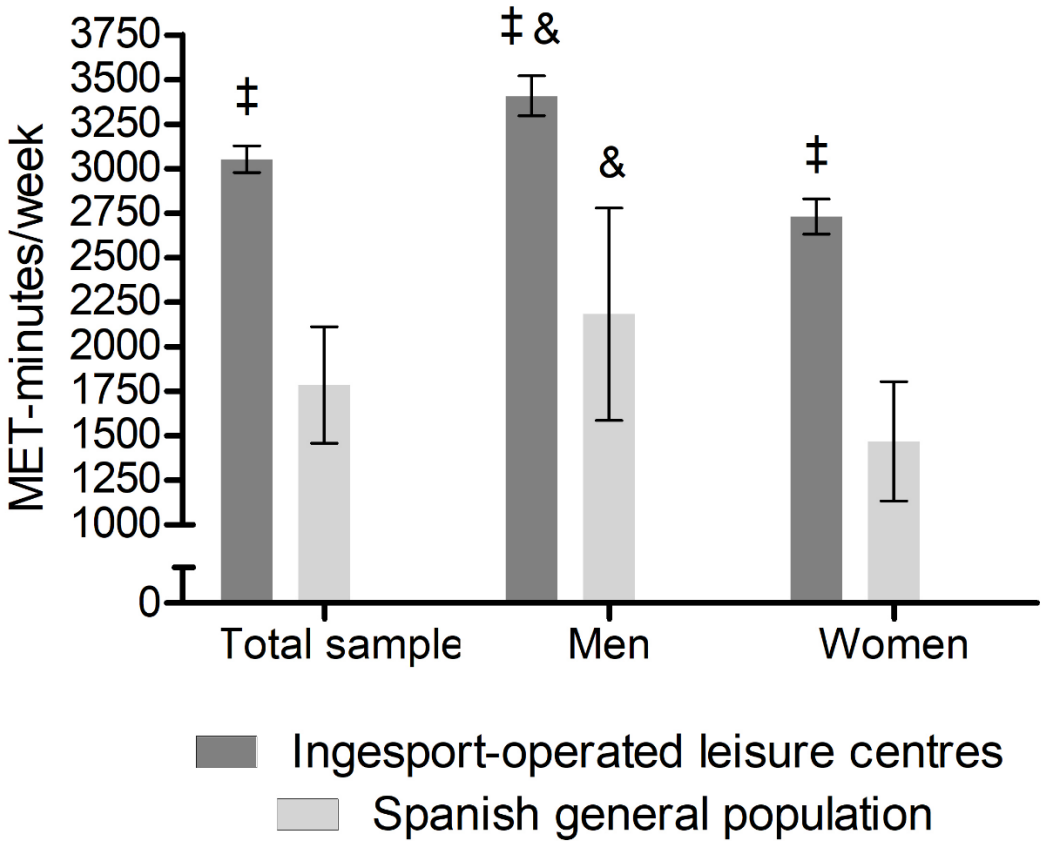

Figure 3. Average total MET-minutes/week between the Leisure Centre and the Eurobarometer for all participants and for men and women separately.

3.5. Discussion

The main findings of this study are that: (a) around 80% of the members of a Spanish leisure centre operator self-report to be active; (b) the prevalence of Low-PA and Moderate-PA in leisure centre members is lower than in the Spanish population, yet the leisure centre members show higher levels of High-PA regardless the age and gender; (c) the prevalence of Low-PA is higher in women in both leisure centres and the general population compared to men; (d) members of leisure centres show less Low-PA for all age brackets than the general population, and (e) the intensity of PA differs according to the total level of individual PA.

The high prevalence of PA in Spanish leisure centres (84.5%) is in line with the prevalence reported in leisure centres from the USA (~ 88%) (Kaphingst et al., 2007, Schroeder et al., 2017). Gjestvang et al., (2019b) using accelerometers found that new members of leisure centres accounted for a lower prevalence of PIA after 12 months than the prevalence of PIA reported by the Norway population in other studies (Hansen et al., 2019, Loyen et al., 2017). However, no one has specifically and directly described the difference in prevalence of PIA among members of leisure centres to that of the general population, particularly with respect to gender and age. Therefore, our finding that leisure centres' members to have a lower prevalence of PIA than the general population regardless of gender and age group is novel.

Regarding gender, women showed higher PIA prevalence than men, in agreement with previous studies (Guthold et al., 2018, Mayo et al., 2019, Mielke et al., 2018). Women also perform less vigorous-PA, which may prevent women from gaining the full benefits of PA (Swain et al., 2020). The positive finding is that women from leisure centres reported much higher High-PA (40.0% vs 13.0%), lower levels of PIA (18.6% vs 37.3%), and higher engagement in vigorous-PA than the general population. Therefore, leisure centres seem to be useful to engage women in regular PA and vigorous PA beyond what is typically seen in the general population. Moreover, women represented 52.3% of the sample from leisure centres, showing that leisure centres might be useful places to support women in decreasing PIA and increasing PA (IHRSA, 2018). The gender differences in leisure centres, i.e., women more engaged in Moderate-PA and men in High-PA, may be due to the way both genders use these centres, their objectives to achieve by working out in fitness centres, and the existence of socio-spatial gendering processes (Coen et al., 2018, MacIntosh and Law, 2015, Salvatore and Marecek, 2010).

This manuscript shows that the prevalence of PIA increases with the age both in leisure centres and in the general population, coinciding with previous studies that reported a higher prevalence of PIA in older adults (Bauman et al., 2009, Carlson et al., 2010). However, the lower prevalence of PIA in all age brackets for leisure centre members enhances the importance of these centres as places of exercise providers (Clavel et al., 2020, IHRSA, 2018, Schroeder et al., 2017). The prevalence of High-PA decreases with age in both samples, yet High-PA was more than twice as high in leisure centre members regardless of age. Therefore, although levels of regular PA are aged-related, members of leisure centres seem to perform more vigorous-PA than the general population (Schroeder et al., 2017) maybe due to the characteristics of the exercise that can be performed in these centres (IHRSA, 2018, Kaphingst et al., 2007, Wickham et al., 2017). Among the different age groups studied, older adults (≥ 60 years old) are a significant target group for PA interventions due to the lower overall engagement in PA (Bauman et al., 2009, Carlson et al., 2010), and also because many older adults have chronic health conditions or disease as a consequence of PIA, or that can be improved by prescribed exercise (Hoffman et al., 2017, Picorelli et al., 2014). This study shows that up to 39.8% of adults between 60 to 69 years old and up to 23.8% of adults > 69 years were classified in the High-PA group. Furthermore, contrary to the trend of the general population, the prevalence of Moderate-PA in leisure centre members improves as age increases. Thus, as suggested by Watts et al., (2017) leisure centres seem to play an important role in supporting older people to stay active. Therefore, leisure centres can likely be considered effective environments for promoting and developing active living and healthy ageing interventions.

The origin of the PA level reported is also a new finding, although a previous study suggested that members from leisure centres exercise more intense than non-members (Schroeder et al., 2017). Gerovasili, et al. (2015) explored the origin of total MET-minutes/week among the European Union Countries, however, they did not make subgroups according to their PA levels nor consider the gender and age of participants. The literature suggests that meeting PA guidelines reduces the likelihood of developing cardiovascular, metabolic, and other non-communicable diseases (Anderson and Durstine, 2019, Ding et al., 2016, Fiuza-Luces et al., 2018, Mozumdar and Liguori, 2011), however, performing vigorous-PA seems to produce additional health benefits (Soares-Miranda et al., 2011, Stamatakis et al., 2018, Swain et al., 2020, Swain and Franklin, 2006). Therefore, even when meeting the PA guidelines there are increased benefits to including additional minutes of vigorous-PA (Soares-Miranda et al., 2011, Stamatakis et al., 2018, Swain et al., 2020, Swain and Franklin, 2006). Vigorous-intensity PA represented a higher proportion of total MET-minutes/week in members of leisure centres regardless the PA group (Low-PA [44.5% vs. 14.0%], Moderate-PA [33.3% vs. 12.2%] or High-PA [57.5% vs. 48.8%]), while walking accounted for more

than 70% of MET-minutes/week in the Low-PA and Moderate-PA groups of the general population. Thus, members of leisure centres, given the greater proportion of higher intensity PA, may derive additional health benefits compared to the general population (Stamatakis et al., 2018).

Previous studies have explored the average MET-minutes/week in adults (Cocca et al., 2014, Gerovasili et al., 2015), however, this has not been done in leisure centre users. GO fit-Ingesport leisure centre members showed an average MET-minutes/week (3051.59) much higher than the general population of Spain, and comparable to the two most active European countries in 2013 (Latvia = 3027; Estonia = 2910) (Gerovasili et al., 2015). On the other hand, the total MET-minutes/week average in 2013 for Spain (Gerovasili et al., 2015) are higher than those found in this study (2166 vs 1784.52), suggesting that the PA levels of Spanish households may have decreased in the last years (Mayo et al., 2019). Regarding gender, the outcomes from total MET-minutes/week also corroborate that men reporting being more active than women (Guthold et al., 2018, Mayo et al., 2019, Mielke et al., 2018). However, once again, leisure centre members of both genders show significantly higher PA levels than the general population.

The ability of leisure centres to engage people from all ages, but specially women and older adults, enforce the suggestion that European countries should develop specific strategies to engage leisure centres in the overall mitigation of population-based PIA (Beedie et al., 2014, Lopez-Fernandez and Jiménez, 2018). These centres can also be used for targeting diseases related to PIA (Beedie et al., 2016, Watts et al., 2017). We acknowledge that many leisure centre members do not regularly exercise within the centres, and that many members leave the centres within the first 6 months (Sperandei et al., 2016, Sperandei et al., 2019). Moreover, a significant proportion of new members report being inactive before enrolling (Sperandei et al., 2016) while the cost of the membership fee might be a barrier for some people (Moreno-Llamas et al., 2020). Thus, we encourage policymakers and the fitness industry to work together in order to increase the accessibility to these centres to low-income people and to develop effective formulas to reduce the gender and age gaps that exist in PA habits (Bauman et al., 2009, Carlson et al., 2010, Mayo et al., 2019). Providing physical activity opportunities according to the gender and age preferences, eliminating socio-spatial gendering barriers and applying behaviour change strategies in these centres might work to improve the effectiveness of leisure centres as physical activity providers and improve access to these places to disadvantaged groups (Coen et al., 2018, Lopez-Fernandez and Jiménez, 2018, MacIntosh and Law, 2015, Middelkamp et al., 2017, Salvatore and Marecek, 2010).

3.6. Limitations, strength, and implications for practice and future research suggestions

Despite the large sample size used in this study, it is important to consider the following limitations. (a) It is possible that highly motivated members were more willing to respond to the survey compared to those who engaged in mostly Low-PA, and that this could bias the results; (b) data from this work were based on self-report questionnaires which may over-report PA levels (Steene-Johannessen et al., 2016), so caution should be despite large samples (c) the Eurobarometer truncate the solutions from the IPAQ questionnaire (Mayo et al., 2019) while the sample from the leisure centres used the classical open solutions (International Physical Activity Questionnaire, 2005), so the total minutes in each category of PA were artificially assumed according to the suggestion of Gerovasili et al. (2015) (d) It was not possible to manage the sample size of both databases used in this study. Thus, causality cannot be stressed from our data; (e) this study only uses data from a large fitness centre chain. Other types of fitness and sports services and centres might have a different impact on the active behaviour of their members.

On the other hand, there are also some particular strengths that need to be acknowledged: (a) This is the first study that describes the prevalence of different levels of physical activity in members of leisure centres according to their age and gender and analyses how this prevalence differs from the general population; (b) It also analyses for the first time the intensity origin of the weekly physical activity performed either by the members of leisure centres and the general population according to age and gender; The database representing leisure centres contains 3,627 responses from sixteen leisure centres that were spread in seven Spanish regions, thereby increasing external validity; (c) the sample used to analyse the PIA prevalence of the Spanish population belongs to the European Commission, and it is used for benchmarking comparisons among EU countries. Further, it was conducted using a multi-stage sampling, random design considering population size and population density what suggest a high accuracy of the outcomes.

Based on the main limitation of this study, future studies should combine device-based and self-report PA instruments to investigate differences in PA prevalence and habits of these two populations. This would allow comparison of effects sizes between different instruments capable of assessing distinct PA constructs and identify any potential discrepancies according to age and gender. Furthermore, future studies should extend the analysis to other modalities of sports services and centres to understand the contribution of each service to the adults' active behaviour.

3.7. Conclusions

Members of leisure centres are mostly active as only 15.5% of members of the members of the Spanish GO fit-Ingesport leisure centres reported to be Low-PA, while 47.0% reported to be High-PA. Moreover, the members of leisure centres showed lower prevalence of PIA and a higher prevalence of High-PA than the Spanish population regardless gender and age. As a consequence, GO fit members showed higher MET-minutes/week than the general population. Differences in PA levels between men and women were confirmed either in leisure centres members or the general population. However, both men and women of GO fit-Ingesport leisure centres showed higher MET-minutes/week than the general population. Vigorous PA represented a higher proportion of total MET-minutes/week in leisure centres' members than in the general population regardless of the PA group (Low-PA; Moderate-PA; High-PA). Moreover, more than 70% of METs in the Low-PA and Moderate-PA of the Spanish population were due to walking.

Chapter 4

Design and validation of a questionnaire to measure the psychosocial factors which influence attendance rates in fitness centres

This is the second empirical chapter of this Doctoral Research. Through this chapter it is aimed to address the following research questions: What are the factors that may be targeted to improve fitness centre attendance? Can these factors gather according to the COM-Model constructs?

This work was conceived for this Doctoral Research by the PhD student. However, it was developed with the collaboration of other authors, and it is expected to get a version of this chapter published in an international journal in the future. Besides conceiving the research, the PhD student actively participated in the development of all the research phases. Accordingly, he defined the methodology followed in this research and was the main responsible for data acquisition. He also participated in data interpretation, validation of the data analysis and drafted the chapter. He has drafted all versions until the final version for this doctoral thesis was achieved, and he took part in all the decision-making processes.

4.1. Abstract and keywords

There is a lack of understanding of how to increase attendance rates at fitness centres to augment physical activity levels. This study aimed to design and validate a questionnaire for measuring factors influencing attendance at fitness centres using the COM-B model. For that, this study involved three phases: i) content generation of the questionnaire items through literature searches and focus groups, ii) expert review of the relevance and clarity of the items to determine sufficient construct validity, iii) assessment of content validity and internal reliability through the administration of an online survey to 180 participants from British fitness centres and 430 participants from Spanish fitness centres. Construct validity of the questionnaire based on the expert review was assessed with the Aiken's Item Content-Relevance Index (Aikens' V), the Index of Content Validity (ICV), and the Coefficient Validity Ratio item (RVC). Content validity was assessed with exploratory and confirmatory factor analysis. Cronbach's alpha was used to analyse the internal reliability. The expert review concluded with a final version of the questionnaire with 35-items (e.g., Aikens' V for relevance and clarity ≥ 0.97). Analysis of content validity and internal reliability of this questionnaire resulted in a 17-item questionnaire (e.g., confirmatory factorial analysis: CMIN/DF = 204; CMIN = 175.497; DF = 86; CFI = 0.965; NFI = 0.919; RMSEA = 0.50; PClose = 0.457). The COM-B based questionnaire developed in this study has acceptable reliability and validity. This questionnaire can be used in future research to develop interventions to improve fitness centre members' attendance rates.

Keywords: Behavior; Behaviour Change Wheel; COM-B Model; Leisure centres; Physical inactivity

4.2. Introduction

The health-related benefits of physical activity (PA), as well as the deleterious impact of physical inactivity (PIA), are well established (American College of Sports Medicine, 2013, Ding et al., 2016, Lee et al., 2012, World Health Organization, 2018b). Thus, the World Health Organization encouraged member countries to achieve a 15% reduction in the prevalence of PIA by 2030 (World Health Organization, 2018a). However, the prevalence of PIA in the European Union increasing by 3.6% between 2013 and 2017, with 41.7% of the European population self-reporting low PA levels (Mayo et al., 2019). Since leisure-time physical activity (LTPA) seems to be especially beneficial for adults' health (Liu et al., 2018, Moore et al., 2016), it might be appropriate to promote this kind of PA as a means to reduce the PIA levels of modern societies.

Recreational facilities such as fitness centres, leisure centres, and community centres for fitness are primary places for adults to perform LTPA (Deloitte and EuropeActive, 2019, IHRSA, 2018); So, they might be useful to address PIA (Beedie et al., 2014, Lopez-Fernandez and Jiménez, 2018, Middelkamp et al., 2017). In fact, regular members at fitness centres report performing more vigorous physical activity than the general population regardless of their age or gender (López-Fernández et al., 2021). Whilst new members at fitness centres attest to having low levels of PA before enrolling in a fitness centre (Sperandei et al., 2016). Furthermore, the use of these centres as a setting for interventions to increase LTPA has clear benefits for long term maintenance of behaviour, as the setting and opportunity for the behaviour remain once the intervention is over (Lopez-Fernandez and Jiménez, 2018, Pavey et al., 2011). However, the low average attendance rate (from 1.1 to 5.6 exercise sessions per month), the low percentage of members (10% to 20%) who exercise there for at least 2-3 times a week (Bağci, 2017, Middelkamp et al., 2016), and the low retention rate (up to 63% of the members leave within the first three months after joining) (Sperandei et al., 2016) evidence that promoting LTPA at fitness centres is challenging. Thus, although centre attendance is not necessarily equivalent to doing LTPA, the authors of this work suggest that future interventions should first target the attendance rate as a way to engage lesser active members in regular LTPA. Moreover, increasing attendance would increase the likelihood of remaining a member of the centre for one year or more (Clavel et al., 2016, Yi et al., 2020).

In order to understand and improve the members' attendance, a strategy grounded in behaviour change science might be useful. Several systematic reviews and meta-analyses have demonstrated the efficacy of specific behaviour change techniques (BCTs) to promote different types of LTPA among diverse populations (Bishop et al., 2015, French et al., 2014, Murray et al., 2017, Nyman et al., 2018, Olander et al., 2013). Particularly, previous studies have applied different psychological frameworks to promote or predict increases in LTPA or attendance in fitness centres, including the Social Cognitive Theory, the PA Maintenance Theory, the Theory of Planned Behaviour and the Transtheoretical Model [stages of change]) (Annesi, 2003, Jekauc et al., 2015, Mazzuca et al., 2017, Middelkamp et al., 2017). However, the visit frequency to the fitness centre (adherence to the proposed PA) was low, which limited the effectiveness of these interventions. Therefore, it seems reasonable to address the attendance rate at fitness centres as a formula to support low active members in improving their current LTPA.

One approach, the Behaviour Change Wheel (BCW) might help to improve the attendance rates at fitness centres because it was developed from a synthesis of nineteen existing behaviour change frameworks to develop a comprehensive understanding of behaviour change (Michie et al.,

2014). Moreover, it is explicitly designed to support both researchers and practitioners in developing behaviour change interventions to achieve the set objective, via a systematic process of behavioural diagnosis, identification of intervention functions and policy context, and selection of the BCTs and implementation options (Michie et al., 2014). Previous studies based on the BCW approach have shown promising results in promoting some kinds of PA (Kinnear et al., 2020, Lau and Faulkner, 2019, Ziebart et al., 2018). The nucleus of the BCW is the "COM-B Model" which suggests individuals need to have the Capability (C; [physical and psychological]), Opportunity (O; [physical and social]), and Motivation (M; [reflective and automatic]) to adopt a new desired behaviour (B) (Michie et al., 2014).

Previous research suggests that developing a questionnaire grounded in the tenets of the COM-B Model might help in the development of interventions for specific health behaviours including PA (Hankonen et al., 2017, Keyworth et al., 2020, Taylor et al., 2016). Furthermore, a previous work found evidence for the predictive validity of COM-B Model for moderate to vigorous PA in a general adult population (Howlett et al., 2017). However, a questionnaire designed to specifically explore the determinants of attendance rate in fitness centres using the COM-B has not to date been developed. Therefore, the aim of this study was to design and validate a behaviour change questionnaire based on the COM-B model which can be used to identify factors which may be targets for change to improve fitness centre attendance.

4.3. Methods

4.3.1. Design

This study was conducted in three phases. First, a pragmatic literature review was conducted, and three focus groups took place to generate the initial items for the Determinants of Attendance Rates in Fitness Centres (DARFC) questionnaire. Second, to assess content validity, two expert review panels participated in a qualitative review of the questionnaire's items. The questionnaire was constructed, and then the content was validated in English. The questionnaire was then translated into Spanish and a Spanish-speaking expert review panel participated in the same qualitative review process. Third, to examine the internal reliability and construct validity of the DARFC questionnaire, a cross-sectional online survey was administered to both English and Spanish-speaking fitness centre members. An external ethics committee from the leading institution where this work was conducted approved the study's development (Codes P60981 and P93622).

4.3.2. Participants and recruitment

4.3.2.1. Focus groups

A random sample of 50 Spanish fitness centre adult members attending four or fewer times in the previous 30 days were requested to participate in the first phase of this study. These members were contacted by their own fitness centre chain and invited to participate in a set of focus groups. The focus groups aimed to discuss the main barriers fitness centre members have to face when attending these places to exercise. The attendance rate criterion was set because membership retention likelihood decreases with average attendance rates of five or fewer times per month (Clavel et al., 2016, Yi et al., 2020). A second criterion to participate in the discussion group was to be low-active according to the short form of the International Physical Activity Questionnaire (International Physical Activity Questionnaire, 2005, Mayo et al., 2019), as the aim was to design a questionnaire focused on inactive individuals. Finally, nine adults (four men and five women) who met these prerequisites agreed to participate in the focus groups. All were informed about the aims and characteristics of the project and consented to participate by signing a written informed consent. The request for inviting more members to be part of focus groups was rejected by the fitness centres contacted for this study. So, it was not possible to increase the number of participants for this phase.

4.3.2.2. External expert review panel

To review the questionnaire items, twenty potential candidates from different universities, countries and backgrounds were invited to be part of the external review panel. The experts were categorised into three groups according to their expertise: (a) managing-level fitness centres professionals with at least eight years of experience (i.e., corporate strategy, expansion, manager; potential candidates, n = 6); (b) doctoral degree-level sports science specialist researching for the fitness industry and obtained a (potential candidates, n = 7); and (c) doctoral degree-level behaviour change specialist with previous experience using the behaviour change wheel and the COM-B Model (potential candidates, n = 7). In total, 13 experts agreed to participate in the study (five fitness centres professionals, four sports sciences specialists, and four behaviour change specialists). The four experts in sports science were bilingual, with Spanish being their first language. These four experts reviewed and validated both the English and Spanish versions of this questionnaire.

4.3.2.3. Construct validity analysis

Fitness centres from Great Britain (n = 10) and Spain (n = 10) agreed to serve as participant recruitment sites for the construct validity surveys. As part of this agreement, the fitness centres would contact their customers via email to invite them to complete an online survey. All 20 centres attract members of all ages, including families. Moreover, they have relatively similar facilities, including group fitness classes, swimming pools, and fitness rooms. To participate in the online survey, participants had to confirm they were at least 18 years old and were paying the membership fee of the participating fitness centre when they completed the survey. There were no exclusion criteria based on PA levels or attendance frequency at the fitness centre was set. The invitation email included an explanation of the project and a link to the survey. Before completing the survey, participants were requested to read the informed consent form and indicate agreement with each statement within the form before progressing to the survey questions.

4.3.3. Procedure

4.3.3.1. Phase 1: Initial draft of the Exercise Behaviour in Fitness Centres Questionnaire

To generate the questionnaire's content, we developed a protocol based on the COM-B Model and the BCW using a similar set of previous research procedures (i.e., a pragmatic literature review and focus groups) (Gould et al., 2017, Westland et al., 2017). The main reason for using the COM-B Model is that it is part of the BCW, an intervention development framework that includes a comprehensive and systematic guideline for researchers (Michie et al., 2014). Moreover, the COM-B Model explains the mechanisms of human behaviour in a more holistic way than other existing behaviour change models.

4.3.3.1.1. Pragmatic literature review

A pragmatic literature review of systematic reviews, surveys, cross-sectional studies and qualitative data were used to complete the COM-B Model (Gould et al., 2017, Westland et al., 2017). The pragmatic literature review aimed to identify recent research evidence that might help identify potential factors that influence fitness centres' attendance rates. The criteria used to identify relevant literature are described in Table 4.

Table 4. Main topic criteria used in the pragmatic review.

Topics criteria
Physical activity/exercise/attendance interventions located or delivered from a fitness centre or similar in healthy adults and/or clinical adults / Research focused on fitness centres or similar that somehow explore possible barriers or factors that can affect the attendance rate
Revisions addressing physical inactivity [physical activity / exercise] or identifying effective methods to enhance physical activity/exercise in adults
Research interventions targeting physical inactivity or exercise in non-clinical adults, healthy adults, and adults without metabolic or cardiovascular disease

The review was limited to works published within the previous ten years (2008-2018). This decision was taken for pragmatic reasons: (a) the initial work developing the BCW approach began in 2008 via the formulation of a behaviour change techniques (BCTs) taxonomy (Abraham and Michie, 2008); (b) evidence review was not the main objective of the present research but capturing the most recent evidence on the attendance rate problem in fitness centres was paramount. Appendix 2 details the methodology followed for completing the pragmatic review and the list of all the research works used to design the items.

4.3.3.1.2. Focus groups

As there was limited research evidence specific to the psychosocial determinants of fitness centre attendance when this thesis was started in 2016, some focus groups were conducted to complement and validate the pragmatic review outcomes. This action has been used in other studies using COM-B Model to study barriers and facilitators in the promotion of health behaviours (Gould et al., 2017, Yi et al., 2020). The initial focus group semi-structured questions were designed based on the findings from the pragmatic literature review. To overcome the limited availability of most participants, three focus groups of three different people were conducted. The average duration of the focus groups was 53 min. During the focus groups, the participants were asked to respond to seven initial questions (Table 5) and further prompted to discuss other topics related to why they infrequently attend the fitness centre to exercise (i.e., reasons). This process was audio-recorded to facilitate an accurate transcription, but no names were recorded to guarantee participants' anonymity.

Table 5. Guidelines for guiding the focus group in identifying the determinants for doing regular physical activity in fitness centres

	Questions to be done in each focus group
1.	Which were your reasons for enrolling in your fitness centre? Are they still the same? Are you accomplishing these reasons or your initial expectations (if yes, explain how; if no, explain why)?
2.	Why are you not regularly exercising in your fitness centre? Which factors are keeping you from? What would you need to change or what would you need from your fitness centre to increase your attendance level?
3.	What does your fitness centre do for encouraging you to have an active lifestyle? What do you think that your fitness centre should change for helping people like you to engage in regular exercise?
4.	Which is your opinion about the role of our trainers? Up to what extend they are helping you or they can help you to be more active (exercise more days a week, accomplish your initial expectations, etc.)?
5.	Why have not you been active in the last few months? Do you have the intention to regularly exercise in your fitness centre?
6.	Up to what extent may your family, work, studies, etc. reduce the number of days you exercise? Do you have caring responsibilities? How can you manage these factors for increasing your physical activity levels?
7.	In the next 5 minutes, please, draw in a paper the people (family, friends, mates, etc.) and factors or reasons (no time, illness, caring responsibilities) that have ever kept you from exercising in the last three months. What happened? Why did you choose not to work out? how will you behave if you are in the same situation in a future nearby (why)? What should be different for you to exercise as planned?

Focus groups were moderated by the author of this doctoral because he was trained for leading focus groups in the past. The seven questions were discussed in the three focus groups. The focus group leader encouraged all members to take part in the discussion and expand statements when it was needed by applying different strategies, including direct questions and inquiries (Krueger, 2014). Furthermore, beverages were provided as part of the strategy to create a warm environment.

The transcription was performed in the two following weeks after conducting the focus group and the audio recording was deleted at the end of this process. Participants' contributions were broken down into statements and each statement was gathered into themes (Appendix 3). Finally, a first draft of the questionnaire was developed by gathering similar statements into potential items and assigning these items into the six sub-constructs of the COM-B Model (Howlett et al., 2017, Michie et al., 2014). These actions were developed by the author of this doctoral thesis together with the supervisor with the highest expertise in the COM-B Model and the Behaviour Change Wheel framework. In addition, this first draft of the questionnaire was reviewed by all members of the supervisory team and nonconformities were solved by full agreement among all researchers.

4.3.3.2. Phase 2: Questionnaire content validity

4.3.3.2.1. Qualitative review of the questionnaire items

The external panel critically reviewed the items generated from the literature search and focus groups. After eight rounds considering the experts' feedback, a final version of the questionnaire was considered (Almanasreh et al., 2019). Each revision round was completed by a minimum of 90% of the experts as some experts asked not to participate in some rounds due to time limitations. For every item, the experts examined the relevance (the degree of the pertinence of targeting the content of this item in fitness centres) and clarity (the degree of easiness to understand the item avoiding ambiguity). Besides, experts were asked to grade their satisfaction with each item and provide qualitative feedback about improving the items. Qualitative feedback included suggestions about deleting, merging, or dividing any item or proposing new ones. Furthermore, behavioural change specialists were asked to review an a-priori COM-B categorisation for each item. Content validity was considered sufficient when all items displayed acceptable scores for both relevance and clarity, and the experts did not ask to add new items or make changes to the phrasing of the existing ones (Almanasreh et al., 2019). Appendix 4 shows an example of the table completed by the experts.

Relevance of the items

Item relevance was measured by a Likert scale from 1 to 4 (1 = totally irrelevant; 2 = somehow irrelevant; 3 = somehow relevant; 4 = totally relevant). Those items rated as irrelevant or somehow irrelevant by four reviewers or more were deleted after the first three revision rounds. The reason to select this cut-off was to avoid deleting possible items that might increase relevance after applying some major changes. From the fourth round onwards, all items that did not show acceptable content validity for relevance were deleted.

Clarity of the items

Item clarity was measured by a Likert scale from 1 to 4 (1 = totally unclear; 2 = somehow unclear; 3 = somehow clear; 4 = totally clear). Items were modified anytime an item did not show acceptable content validity for clarity. Whenever an item achieved sufficient consensus among experts about its clarity, it was no longer modified.

Overall satisfaction with the item

Using a nine-point Likert scale from 1 (lowest) to 9 (highest), reviewers set their overall satisfaction with each item. This scale was used to assess the items' quality, besides relevance and clarity. Items receiving a score below 7 were reviewed as this low qualification might indicate that further improvement was needed. To this purpose, we used the information provided by the qualitative feedback that is described below.

Qualitative feedback

The reviewers were instructed to provide qualitative feedback when rating an item as totally unclear, somehow clear, or a global satisfaction below 7. Reviewers were also free to provide any improvement suggestion they considered relevant without word limitation (i.e., suggesting new items to address in each section, merging two or more items into one; or any other improvement).

4.3.3.2.2. Spanish version of the questionnaire

The approved version of the DARFC questionnaire was translated into Spanish by the first author and reviewed by the remaining Spanish authors. The Spanish version of the questionnaire was critically reviewed by the four sport and exercise scientists who participated as external experts in the questionnaire's content validity (English version). Three revision rounds were required to achieve a version with all the items showing sufficient translation content validity.

A four-point Likert scale was used to assess the accuracy of the translation (1 = not accurate at all; 2 = somehow not accurate; 3 = somehow accurate; 4 = very accurate) and the clarity of the translation (1 = Totally unclear; 2 = somehow unclear; 3 = somehow clear; 4 = totally clear). The translation of each item was improved if the average score from the external panel for accuracy or clarity was below 3 and/or did not show sufficient content validity. Reviewers were instructed to provide qualitative feedback when rating an item below 3 either on the accuracy or the clarity. Besides the accuracy and clarity, a nine-point Likert scale was also used to assess the translation's satisfaction. Thus, all items rated below 7 were also improved (Appendix 5 shows a copy of the table that experts had to complete as well as the content validity of the translation).

4.3.3.3. Phase 3: Reliability and validity of the questionnaire

4.3.3.3.1. Design of the online survey

The expert panel process ended once the construct validity of the DARFC questionnaire was high enough. In this third phase construct validity of the questionnaire was tested. To do so, first, an online version of this questionnaire was administered to members of fitness centres. This questionnaire was administered together with two additional questionnaires to gather further information from respondents. Accordingly, participating members of fitness centres received an invitation to respond to an online survey divided into three sections. The first section of the survey included the International Physical Activity Questionnaire short form (IPAQ-SF) (Hagströmer et al., 2006). This questionnaire has been used in other studies targeting fitness centres members (MacIntosh and Law, 2015), being also validated in Spanish (Roman-Viñas et al., 2010). The DARFC was placed in the second place of the survey. The final section of the survey included demographic questions: gender, age, attendance at the fitness centre in the previous week, and the fitness centre where they are enrolled.

The survey was conducted online for pragmatic reasons: 1) to reach members of fitness centres who never or barely go to fitness centres to exercise, although it was not possible to have control over the invitation emails; 2) because, managers of fitness centres participating in this phase were not willing to accept having a person asking their members to complete a survey at the gate of the centres for brand image reasons; 3) because online surveys permit higher control of communication actions from fitness centres and provide higher flexibility to potential respondents to answer the survey; 4) because online survey permits inviting members from the same fitness chain but exercising in different fitness centres, increasing the sample universe.

4.3.3.3.2. Survey responses

The survey was opened online for one month. As soon as the survey was opened, participant fitness centres sent an email to their members requesting them to complete the survey. A reminder to complete the survey was also sent 15 days before the closing dates. No further interaction with members of fitness centres. Emails were sent by the participant fitness centres without any kind of supervision from the research team.

Once survey was over, respondents were gathered into low attendance if exercising at the fitness centre was less than two times per week, moderate attendance if they exercised at the

fitness centre two but less than four times per week, and high attendance if they exercised four or more times a week at their fitness centres (Gjestvang et al., 2019a, Pierce, 2018).

4.3.4. Data analysis

4.3.4.1. Focus groups and pragmatic review analysis

Thematic analysis was used to code the findings from the pragmatic literature review and each focus group into themes (Braun and Clarke, 2012). This coding scheme was used to design the items of the initial draft of the questionnaire. Finally, items were gathered into the six components of the COM-B Model (Michie et al., 2014).

4.3.4.2. Content validity of the DARFC questionnaire

The questionnaire's content validity through the expert's panel was assessed by analysing the agreement's grade upon experts for both items' relevance and clarity. The content validity analysis was calculated for all the items and the whole questionnaire. For this, the following tests were applied: the Aiken's Item Content-Relevance Index (Aiken, 1985, Dunn et al., 1999, Penfield and Giacobbi, 2004), the Coefficient Validity Ratio (RVC) (Ayre and Scally, 2014, Lawshe, 1975) and The Index of Content validity (CVI) (Lynn, 1986, Polit et al., 2007).

Aiken's V for both relevance and clarity were assessed by comparing the experts' scoring from 1 to 4. The RVC and CVI for relevance, clarity, or accuracy (in the case of the Spanish version) were calculated by comparing the irrelevant and clarity scoring (totally irrelevant/clear + somehow irrelevant/clear) against the relevant /clear scoring (somehow relevant/clear + totally relevant/clear). According to Aikens' V, RVC, or CVI, all items whose reliability score was unacceptable were deleted from the third expert revision round onwards. Regarding items' clarity, all items that evidence a poor RVC or CVI were modified until achieving acceptable values. In the last revision round, all items were graded as 3 or 4. Therefore, the RVC and CVI were calculated by comparing the outcomes "somehow relevant" against the outcomes "totally relevant", while for clarity, they were calculated by comparing the outcomes "somehow clear" against the outcomes "totally clear".

4.3.4.3. Construct validity and internal consistency reliability of the DARFC questionnaire

Descriptive statistics for the responses from fitness centres' members are reported as mean ± standard deviation (SD). The homogeneity and the variance asymmetry were calculated by the

Levene's test and the Kolmogorov-Smirnov test, respectively. The internal consistency reliability of the questionnaire was assessed by calculating the Cronbach's Alpha (Acceptable > 0.7; questionable > 0.6; poor >0.5; Unacceptable < 0.5). The Spearman's correlation was used to calculate the variance difference among the same COM-B component items. We used a factor analysis approach to assess construct validity by using both exploratory and confirmatory factor analysis methods (Bolarinwa, 2015). The exploratory factorial analysis was conducted using SPSS version 25 (IBM SPSS, Armonk, NY, USA). The maximum likelihood extraction method and the Promax rotation were used to identify the best fitting model (Treiblmaier and Filzmoser, 2010). Eigenvalues greater than one were set to determine the number of factors to retain in the final model. The validity of the model was assessed by analysing its adequacy (KMO [> 90 = Marvellous; > 80 = Meritorious; > 70 = Middling > 60 = Mediocre; > 50 = Miserable; < 50 = Unacceptable]; Bartlett's Test of Sphericity [sig. < 0.05 = it is not an identity matrix]; Communalities [> 0.4 was considered acceptable]); convergent validity (factors loading > 70 = adequate; > 60 = sufficient); discriminant validity (Factor Correlation Matrix with correlations < 0.7); and factor structure (no cross loading over 0.3 was considered acceptable) (Costello and Osborne, 2005, Reio Jr and Shuck, 2015). Cronbach's alpha of each factor and the whole model were also calculated to identify its reliability. It was defined as $\alpha > 0.9$ = Excellent; $\alpha > 0.8$ =Good, $\alpha > 0.7$ = Acceptable, $\alpha > 0.6$ = Questionable, $\alpha > 0.5$ = Poor, and $\alpha > 0.5$ = Unacceptable (George and Mallery, 2003). The items' lack of variability was defined by the standard deviation of the items, as suggested in the previous studies (Dyson et al., 2013). In this case, the cut-off point was defined greater than 1.1.

Once a promising model was determined, it was verified by conducting a confirmatory factorial analysis SPSS AMOS version 25 (IBM SPSS AMOS, Armonk, NY, USA). The model fit of this analysis was assessed using the following goodness of fit statistics: the $\chi 2$ (CMIN), the degrees of freedom (DF), the $\chi 2$ value/degrees of freedom (CMIN/DF),the Comparative fit indices (CFI: < 0.9 = Terrible; < 0.95 = Acceptable; > 0.95 = Excellent); the root mean square error of approximation (RMSEA: > 0.08 = Terrible; > 0.06 = Acceptable; < 0.06 = Excellent); the *p* of close fit (PClose: < 0.01 = Terrible; < 0.05 = Acceptable; > 0.05 = Excellent); standardised root mean square (SRMR > 0.10 = Terrible; > 0.08 = Acceptable; < 0.08 = Excellent). The convergent validity of the confirmatory factorial analysis was assessed by examining the factor loadings of each measurement's latent variable quantified from manifest variables (> 0.5 = acceptable; > 0.7 = Marvellous) (Brown, 2014, Hair Jr et al., 2016). While the discriminant validity of this analysis was assessed by examining the diagonal covariance (>0.8 = Acceptable) (Hair et al., 2010, Malhotra and Dash, 2011). Moreover, the average variance extracted (AVE) and composite reliability (CR) were also analysed.

4.4. Results

4.4.1. Content validity of the DARFC questionnaire

The outcomes from the last expert's panel rating for relevance, clarity, and overall satisfaction with the items are displayed in Table 6. A total of 35 items obtained acceptable content validity, according to the experts' panel criteria. The items are grouped as follows: Reflective Motivation = 7 items; Automatic Motivation = 4; Social Opportunity = 4; Physical Opportunity = 11; Physical capability = 3; Psychological Capability = 6.

Table 6. Outcomes of relevance, clarity and overall satisfaction with the items according to the last revision round performed by the expert's panel.

COM-B component	Items	Relevance (graded from 1 to 4)	Clarity (graded from 1 to 4)	Overall Satisfaction with the items (graded from 1 to 9)
Reflective Motivation	RM1: Being active is important	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	RM2: willing to make changes to exercise more	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	RM3: Lack have goals to achieve by exercising	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	RM4: Planning how much exercise to perform	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	RM5: Importance of having an exercise programme	3,90 ± 0,32	3,90 ± 0,32	8,80 ± 0,42
	RM6: Being sore or tired due to exercising keeps from exercising	3,90 ± 0,32	3,90 ± 0,32	8,60 ± 0,70
	RM7: Receiving feedback about improvements	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
Automatic Motivation	AM1: Do not feel like exercising at a fitness centre	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	AM2: Exercising at a fitness centre is boring	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	AM3: Intimidated when exercising at the fitness centre	3,90 ± 0,32	4,00 ± 0,00	9,00 ± 0,00
	AM4: Feeling good after exercising	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
Social Opportunity	SO1: Support from people who matters	4,00 ± 0,00	3,90 ± 0,32	8,90 ± 0,32
	SO2: Possibility to exercise with others	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	SO3: Feeling of belong at my fitness centre	3,90 ± 0,32	3,90 ± 0,32	8,80 ± 0,42
	SO4: People from my circle also exercise	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
Physical Opportunity	PO1: Easy to get to the fitness centre	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PO2: Opening hours of the fitness centre	4,00 ± 0,00	4,00 ± 0,00	8,90 ± 0,32
	PO3: Exercise options offered at the fitness centres	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	PO4: Influence of the daily responsibilities	3,90 ± 0,32	3,90 ± 0,32	8,80 ± 0,42
	PO5: Booking exercise services in advance	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PO6: Exercise options available for different levels/ability/fitness	3,90 ± 0,32	3,60 ± 0,84	8,60 ± 0,70
	PO7: Access equipment/classes in rush hours	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PO8: Availability of an individualised exercise programme	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	PO9: Discussing the exercise program with the staff	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	PO10: Support from the staff about exercising	3,90 ± 0,32	4,00 ± 0,00	8,90 ± 0,32
	PO11: Supervision from the staff	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
Physical Capability	PhC1: No health condition/illness that contraindicate exercising	4,00 ± 0,00	3,90 ± 0,32	8,90 ± 0,32
	PhC2: Not physically able to perform the planned exercises	3,90 ± 0,32	3,90 ± 0,32	8,70 ± 0,67
	PhC3: Lack of energy to exercise	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
Psychological Capability	PsC1: Knowledge of the benefits of being physically active	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PsC2: Knowledge of how much exercise to be healthy	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PsC3: Personal importance for self-monitoring	4,00 ± 0,00	4,00 ± 0,00	9,00 ± 0,00
	PsC4: Lack of knowledge about how to use the equipment	3,90 ± 0,32	3,90 ± 0,32	8,80 ± 0,42
	PsC5: Ignorance about how to perform the planned exercises	3,90 ± 0,32	3,90 ± 0,32	8,80 ± 0,42
	PsC6: Ignorance about the benefits of doing the planned exercises	3,90 ± 0,32	4,00 ± 0,00	8,80 ± 0,42

Data are presented in form of mean ± SD
RM = Reflective Motivation; **AM** = Automatic Motivation; **SP** = Social Opportunity; **PO** = Physical Opportunity; **PhC** = Physical Capability; **PsC** = Psychological Capability.

The outcomes from expert's panel content validity (Aiken's V, Lawsge's RVC, and Lynn's CVI) for all the items and the whole questionnaire are displayed in Table 7. Regarding the 35 items, either for relevance or clarity, the Aikens' V was ≥ 0.97; the 95% coefficient interval difference (upper limit - lower limit) was ≤ 0.16; the RVC was ≥ 0.80, and the CVI was ≥ 0.90. In the case of the whole questionnaire, the Aikens' V was 0.980 for relevance and 0.990 for clarity, the 95% coefficient interval difference (upper limit - lower limit) was 0.142 either for relevance and clarity, the RVC was ≥ 0.88 for relevance and 0.943 for clarity, and the CVI was 0.940 for relevance and 0.971 for clarity.

4.4.2. Final version of the DARFC questionnaire:

The approved version of the questionnaire (Appendix 6) was made of 35 items. The items were mapped into six categories that represent the six components of the COM-B Model. The questionnaire's six categories were randomly distributed but keeping the three original COM-B domains (motivation, opportunity, and capability). Thus, the questionnaire is divided into these three sections. Moreover, to reduce the risk of leading the participants' response, the experts agreed on 19 items to be written positively. In contrast, the remaining 16 were written negatively.

4.4.3. Construct validity of the questionnaire and internal consistency reliability of the DARFC questionnaire

A total of 180 and 430 adult fitness centres members for the British and Spanish operators respectively completed the 35-item questionnaire (Table 5).

Table 5. Characteristics of the adult members from British and Spanish fitness centres participating in this study.

Sample		Physical activity levels[λ]		Attendance level[¥]		
		Low-PA	MVPA	≤1 days/week	2-3 days/week	≥ 4 days/week
Female	381	93	288	99	165	115
Males	229	36	193	42	88	94
All respondents	610	129	481	141	253	209

λ: The physical activity levels of participants were calculated according to the guidelines for the IPAQ short version International Physical Activity Questionnaire (International Physical Activity Questionnaire, 2005)

¥: The attendance level was set based on the suggestion to previous studies (Gjestvang et al., 2019b, Pierce, 2018)

LOW-PA: Those members who, according to the IPAQ short version questionnaire, are declared as having Low-PA.

MVPA: Those members who, according to the IPAQ short version questionnaire, are moderately or highly active.

The exploratory factor analysis with the 35 items showed 11 dimensions with no clear pattern for each of the six components of the COM-B Model. The failure in the exploratory factorial analysis shows the complexity of the COM-B Model in which each component is mapped by different psychological constructs (Michie et al., 2014), suggesting that the 35-item might not be reliable enough. At this point, it was decided to explore if a simpler model might derive from the original 35-item questionnaire. The reasons for this decision were based on questionnaires with lower items that can reduce participant burden and some items might be corrupting the model (Costello and Osborne, 2005, Reio Jr and Shuck, 2015). Thus, using an interactive process, the number of items was reduced until identifying an acceptable model. The item PsC1 was removed because 98.7% of respondents totally agreed or agreed, thus not having discriminatory capacity. Moreover, RM1, RM6, SO4, PO4, and PsC3 were removed from the model. We found that deleting these items would increase the Cronbach's alpha by at least 0.1 points on their corresponding component, reducing noise in the model. Finally, the exploratory factorial analysis was used to identify and extract from the model the items with a lower weight. Based on this, items RM3, RM4, AM3, SO3, PO1, PO2, PO3,

PO7, PO9 were removed. The final model contained the six constructs of the COM-B represented as latent factors. However, the physical capability was only represented by one item (PhC1). Further, the model gathered an item from physical capability (PhC3) within Automatic Motivation. Lastly, Physical Opportunity was represented by two different domains. Because a confirmatory factorial analysis cannot be conducted if a dimension is only represented by one item, the PhC1 was not included when analysing the construct validity of this model by means of the exploratory factorial analysis and confirmatory factorial analysis and its reliability. The scoring average and the standard deviation of the 16 items used for these analyses, plus the average score of the PhC1 (17 items in total) are displayed in Table 8.

Table 8. The scoring average and standard deviation of the 17-items from the final version of the DARFC questionnaire

Item	Response range	Mode	Median	Mean	SD
RM2: willing to make changes to exercise more	1-5	4	4.1	4,1	1,2
RM5: Importance of having an exercise programme	1-5	5	3.9	3,9	1,2
RM7: Receiving feedback about improvements	1-5	5	4.0	3,9	1,2
AM1: Do not feel like exercising at a fitness centre	1-5	4	4.0	3,7	1,2
AM2: Exercising at a fitness centre is boring	1-5	4	4.0	3,9	1,1
PhC3: Lack of energy to exercise	1-5	5	4.0	3,8	1,2
SO1: Support from people who matters	1-5	5	4.0	3,9	1,1
SO2: Possibility to exercise with others	1-5	4	4.0	3,7	1,1
PO5: Booking exercise services in advance	1-5	5	4.3	3,2	1,2
PO6: Exercise options available for different levels/ability/fitness	1-5	4	4.0	4, 1	1,1
PO8: Availability of an individualised exercise programme	1-5	5	4.0	4,1	1,2
PO10: Support from the staff about exercising	1-5	5	4.0	4,2	1,1
PO11: Supervision from the staff	1-5	4	3.9	3,9	1,2
PhC1: No health condition/illness that contraindicate exercising	1-5	5	4.8	3,9	1,1
PsC4: Lack of knowledge about how to use the equipment	1-5	4	4.0	4,0	1, 2
PsC5: Ignorance about how to perform the planned exercises	1-5	5	4.0	3,8	1,2
PsC6: Ignorance about the benefits of doing the planned exercises	1-5	5	4.0	4,1	1,1

4.3.4.4. Analysis of the model fit through the Exploratory Factorial Analysis

Table 9 shows the pattern matrix of the identified model. The model showed acceptable adequacy (KMO = 0.0774; sig < 0.001; all communalities are greater than 0.4 (lower value = 5.50); the redundant residuals were less than 3% (2.2%); and the six-factor model explained 70.006% of the variance. The convergent validity was confirmed since factor loadings are higher than 0.7, except for PO11 (0.678) and PsC6 (0.639). Discriminant validity was also confirmed as no strong cross-loadings were found (< 0.3) and the factor correlation matrix did not show values above 0.7 (Highest value = 0.420).

Table 9. Model's Pattern matrix of Confirmatory Factorial Analysis in a sample of adult fitness centres members (n = 610).

Pattern Matrix[a]

	Component					
	RM	AM	SO	PO_1	PO_2	PsC
RM2	,736					
RM5	,825					
RM7	,751					
AM1		,884				
AM2		,778				
PhC3		,770				
SO1			,873			
SO2			,732			
PO5				,802		
PO6				,841		
PO8					,806	
PO10					,874	
PO11					,639	
PsC4						,956
PsC5						,945
PsC6						,678

Extraction Method: Maximum Likelihood. *Rotation Method*: Promax with Kaiser Normalization. Rotation converged in 6 iterations.
RM=Reflective Motivation; AM=Automatic Motivation; SO=Social Opportunity; PO_1=Physical Opportunity first subdimension; PO_2=Physical Opportunity second dimension; PsC=Psychological Capability

4.3.4.5. Reliability of the model

Cronbach's Alpha of the whole model was 0.774. Automatic Motivation (0.776), the second sub-dimension of Physical Opportunity (PO_2; 0.742), and Psychological Opportunity (0.849) showed acceptable Cronbach's Alpha. On the contrary, Reflective Motivation (0.699) showed questionable reliability and either Social Opportunity (0.527) or the first sub-dimension of Physical Opportunity (PO_1; 0.576) showed poor reliability.

4.3.4.6. Analysis of the model fit through the Confirmatory factorial analysis

The confirmatory factorial analysis showed an acceptable model fit (Figure 4) because CMIN/DF was acceptable (204; CMIN = 175.497; DF = 86); CFI was excellent (0.965); NFI was acceptable (0.919); RMSEA was excellent (0.50); and PClose was excellent (0.457). The convergent validity of the model showed all factor loadings over 0.6 except SO2 (0.55) and RM2 (0.56), while the discriminant validity showed diagonal covariances lower than 0.8 (The higher one was 0.64). Finally, the AVE (> 0.5) and CR (> 0.7) were found to be acceptable.

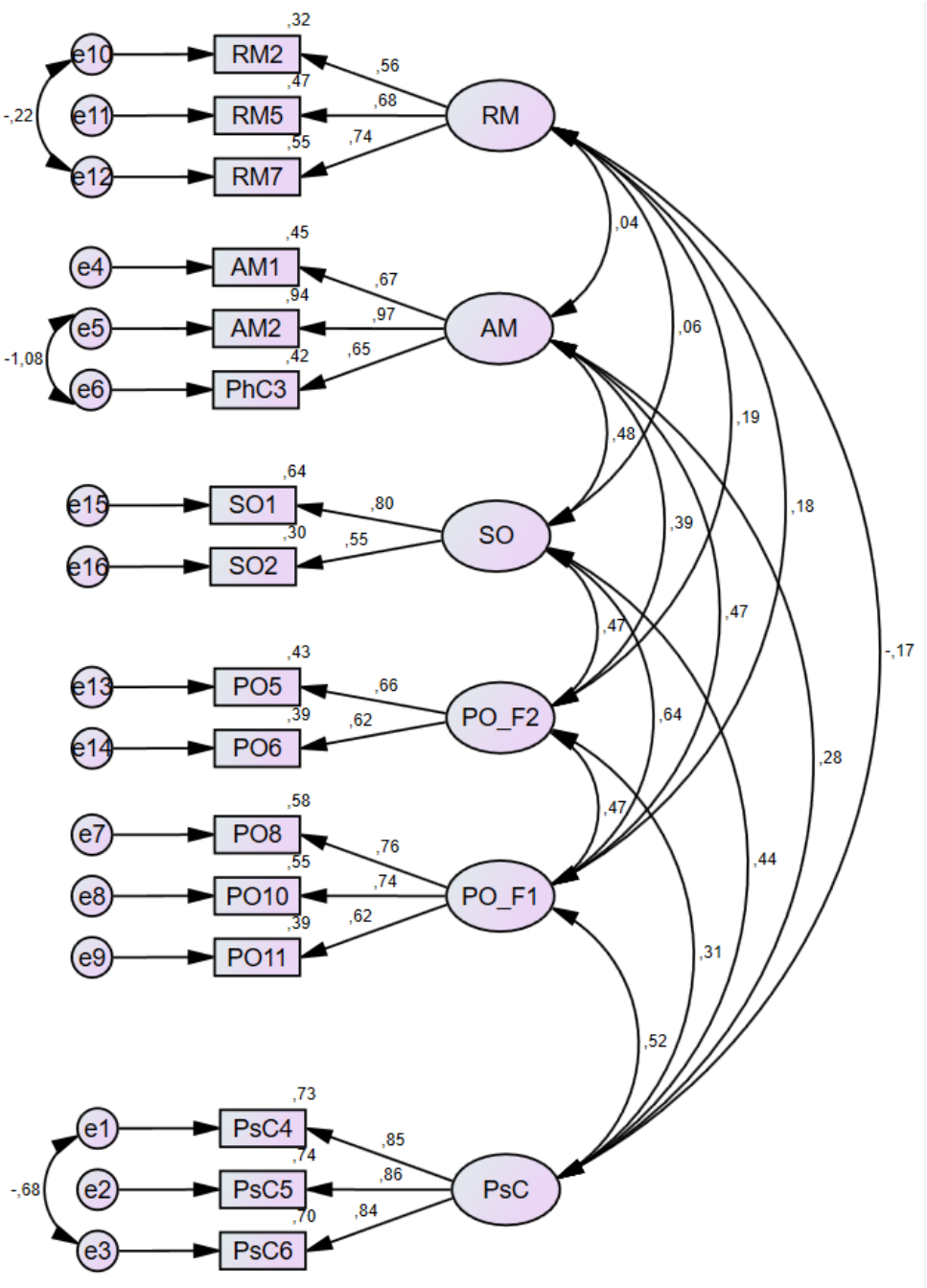

Figure 4. Outcomes from the confirmatory factorial analysis

4.5. Discussion

The current work aimed to design and validate a behaviour change questionnaire based on the COM-B model that measures what the members of fitness centre might need to change in order to increase their attendance rate, as a way to improve their PA levels. The 35-items questionnaire showed excellent content validity. Nevertheless, only the 17-items version showed acceptable construct validity. There are other questionnaires in the literature using a COM-B Model based

questionnaire to explain PA (Hankonen et al., 2017, Keyworth et al., 2020, Taylor et al., 2016). However, none of these questionnaires were specifically designed to inform the development of an intervention to increase the attendance rate of members of fitness centres as a means to increase PA. From a sports management perspective, several surveys attempting to identify the key factors associated with members dropping out of fitness centres were published (Nuviala Nuviala et al., 2012, Zarotis et al., 2017b). However, preventing drop-out and increasing attendance are two different goals with likely related but distinct determinants (Clavel et al., 2016, Clavel et al., 2020). Therefore, future research and interventions should focus on the 17 items of this model.

The failure in the exploratory factorial analysis when analysing the 35-items might be explained by the complexity of the COM-B Model, which each component includes different psychological constructs (Michie et al., 2014). An example of the complexity of the COM-B Model can be found by the inclusion of the TDF framework within this Model, as each component of the COM-B Model gathers several constructs from the TDF (Atkins et al., 2017, Michie et al., 2014). Also, the fact of each COM-B component is mapped by different constructs might explain the limited Cronbach's alpha of some dimensions of the implemented questionnaire. Based on these points, a validation of the 35-items questionnaire using the TDF might make sense, and it would maintain the relationship with the COM-B Model (Atkins et al., 2017, Michie et al., 2014). However, the content validity of the questionnaire was developed only based on the COM-B Model because when the first stage of this research was conducted (2016), the guideline applying the TDF was not published yet (Atkins et al., 2017). Thus, although TDF and COM-B Model are related, modifying the theoretical framework at the construct validity phase might bias the outcomes. Also, the TDF framework is made of 14 factors (Atkins et al., 2017), so a more complex questionnaire might derive from the use of the TDF. Accordingly, the author of this doctoral thesis opted for examining if a simpler questionnaire can be derived from the original questionnaire maintaining the COM-B Model approach. Nonetheless, he also acknowledges the limitation of the approach presented in this chapter and encourages future studies to explore the effectiveness of the TDF to identify the main barriers and facilitators for attending fitness centres to exercise.

The 17-items questionnaire identified through the exploratory factorial analysis suggests that a simpler model might be effective to explain the main factors behind the attendance behaviour at fitness centres. In this regard, the 17-item questionnaire showed acceptable model fit (70.0% of the explained variance), acceptable adequacy, and acceptable discriminant validity (Costello and Osborne, 2005, Reio Jr and Shuck, 2015). Items PO11 (0.678) and PsC6 (0.639) showed a factor loading lower than 0.7 that could negatively affect the validity of the model. However, they were

included due to their factor loading being almost 0.7. The Confirmatory Factorial Analysis was acceptable enough to support keeping these items in the model (Bolarinwa, 2015). Regarding the Cronbach's Alpha, three dimensions showed an $\alpha < 0.7$ what might compromise the model's reliability. However, it is probable that the low value of these dimensions is because they are made by two-items that might underestimate the Cronbach's Alpha (George and Mallery, 2003). This reason, together with the finding that none of the items showed an $\alpha < 0.5$, indicates the model has acceptable reliability (George and Mallery, 2003, Tavakol and Dennick, 2011). However, future studies should investigate the test-retest validity of this questionnaire to confirm its reliability (Keyworth et al., 2020, Taylor et al., 2016).

Regarding the Confirmatory Factor Analysis, the model fit showed acceptable to excellent values for all the variables (Brown, 2014, Hair Jr et al., 2016) with acceptable values for AVE and CR and therefore acceptable adequacy (Hair et al., 2010, Malhotra and Dash, 2011). Therefore, despite the limitations reported in the previous paragraph, we think the proposed model is sufficiently acceptable to be used in developing future interventions. On the other hand, most respondents reported to be active and to exercise at fitness centres for at least 2 days per week. This might explain the small standard deviation of some of the items and therefore influence the validity and reliability of the model (Dyson et al., 2013, Taylor et al., 2016). However, the model's items surpassed the expected variability (1.1. in standard deviation), but SO1 whose score was near 1.1. (1.098); which increases confidence in the acceptability of this model. The cut-off for items variability was set based on previous studies (Dyson et al., 2013, Taylor et al., 2016); but set as ≥ 1.1 standard deviations because this study used a 5-points Likert scale instead of a 7-point Likert scale.

Having a reliable measure of the ecological model in which psychosocial and environmental determinants of attendance at fitness centres are contemplated is essential for effective intervention development using the BCW approach. In this regard, it is possible that the 17-items model identified in this study does not apply to all the fitness centres. Since the theoretical 35-items questionnaire identified in this model were shown to have excellent content validity (Ayre and Scally, 2014, Lawshe, 1975, Penfield and Giacobbi, 2004), future studies could use these items to identify the model that better fits with the characteristics of the targeted centres. In other words, it might be that all the 35 items apply for a fitness centre, but the relevance of some items might differ from other fitness centres with different characteristics to those used in this study. The 35-items questionnaire was built according to a pragmatic literature review and three-focus groups following the guidelines from the BCW (Gould et al., 2017, Michie et al., 2014, Westland et al., 2017), and was reviewed by 13 different experts until achieving sufficient content validity (Ayre and Scally, 2014,

Penfield and Giacobbi, 2004, Polit et al., 2007). Thus, it might be used to identify the better model fit for other types of fitness centres. On the other hand, the 17-items model has the six categories of the COM-B Model (Michie et al., 2014). However, physical opportunity was subdivided into two categories instead of remaining single, which suggests that this dimension targets more than one construct, but future studies are required.

4.6. Limitations, strength, and implications for practice and future research suggestions

Despite reporting acceptable content and construct validity, this study has a set of limitations that need to be acknowledged: (a) The prevalence of physical inactivity was calculated based on a self-report online questionnaire (IPAQ) which might over-report PA level (Rzewnicki et al., 2003). (b) The attendance level was also measured by a self-reported question, so it is possible some participants over reported their attendance rate. (c) The sample was not equally distributed with only 21% of participants being inactive according to the IPAQ-SF criteria (International Physical Activity Questionnaire, 2005). (d) There is a disparity in the number of items from each dimension with two dimensions having two items and one dimension having only one item. (e) Respondents only completed the questionnaire once, so it was not possible to study the predictive validity or intra-subject reliability. (f) Each of the six constructs of the COM-B Model includes different psychological domains (Atkins et al., 2017, Michie et al., 2014), which might explain the lack of construct validity of the 35 items model and increase the possibility of respondents misinterpreting the approach of some items.

On the other hand, there are also some strengths that should be recognised: (a) the design of the 35-items questionnaire and the 17-items questionnaire was informed by a literature review and some focus groups. (b) more than ten experts from different background participated in the validation of the 35-itmes questionnaire, and it was reviewed several times until achieving a very high content validity. (c) the variance explained by the 17-items model is very high at 70%, both the exploratory and confirmatory factorial analysis show acceptable outcomes, and this model respects the structure of the COM-B Model.

Based on the outcomes of this study, future studies might study the effectiveness of the 17-items questionnaire to guide interventions targeting attendance in fitness centres. To do so, each item of the questionnaire should be linked to different behaviour change techniques. Also, future research might attempt to analyse the predictive validity of this questionnaire and increase the

sample size of low-attendance members. On the other hand, the 35-items questionnaire and the 17-items questionnaire have been designed following a systematic approach based on the evidence, so they can be used to inform marketing and strategy decisions of fitness centres despite their limitations. Finally, given the complexity of the COM-B Model, future studies might check the use of the TDF to guide the development of a similar questionnaire like the one here proposing.

4.7. Conclusions

The 35-items questionnaire showed excellent content validity, but only the 17-items version showed acceptable construct validity. Therefore, we recommend using the 17-item version of the DARFC questionnaire to develop future interventions to increase attendance at fitness centres.

4.8. Acknowledgments

The authors thank Dr Caroline Wilson PhD., Dario Cruz, David Pozos, Dr Ivan Clavel PhD., Dr Javier Sánchez-Sánchez PhD., Dr Jorge García-Unanue PhD., Dr Kristina Curtis PhD., Dr Lauren Connell PhD., Dr Lou Atkins PhD., Marco Bergamin, Dr Neil Howlett PhD., Dr Sergio Rodriguez-Cañamero PhD., and Dr Steve Man PhD. for critically reviewing the questionnaire validated in this study and acknowledge that their contribution was essential in the development of this work. The experts voluntarily provided valuable feedback by identifying the irrelevant items or those items that somehow are unenforceable for fitness centres. They were also very helpful in writing the final version of each item by providing outstanding suggestions to make all items sufficient clear and by reviewing that each item targets the desired behaviour change construct according to the COM-B Model. Finally, the experts' excellent feedback helped the authors identify which items needed to be merged into one and, in some cases to design new relevant items. On the other hand, the authors also acknowledge the contribution of Abbeycroft Leisure as they helped us to reach the sample required to validate the questionnaire presented in this research study.

Chapter 5

Development of a behaviour change intervention framework to increase attendance of fitness centres

This is the third empirical chapter of this Doctoral Research. Through this chapter it is aimed to address the following research questions: What are the characteristics that has to have an intervention targeting fitness centres attendance? What are the main BCTs that can be used to deliver this intervention? This chapter has been prepared for publication but has not been sent to a journal by the time the Doctoral Research has been submitted. The version displayed below is the latest available version.

This work was conceived for this Doctoral Research by the PhD student. However, it was developed with the collaboration of other authors. Besides conceiving the research, the PhD student actively participated in the development of all the research phases. Accordingly, he defined the methodology followed in this research and was the main responsible for data acquisition. He also participated in data interpretation, validation of the data analysis and drafted the manuscript. Finally, he participated in all drafted versions until the final version was achieved, and he took part in all the decision-making processes.

5.1. Abstract and keywords

Attendance might be a feasible behaviour to target by fitness centres to increase the physical activity (PA) levels of their members. However, low research exists in this regard. This study aimed to develop an intervention framework grounded in the BCW to increase attendance rates. In line with the Behaviour Change Wheel (BCW) and the Theoretical Domains Framework (TDF) an intervention framework was developed. The development was divided into two phases. Phase 1. consisted of the development of a pragmatic literature review to get further understanding of the problem, develop a conceptual map with the main factors behind attendance to a fitness centre to exercise and to inform the different steps of the intervention framework development. Phase 2. consisted of the intervention framework development according to the guidelines of the BCW. The pragmatic literature review revealed the main factors behind fitness centres' attendance. The intervention framework identified inactive members who attend the centre less than two times/week will benefit the most from the intervention. Furthermore, each the main identified barriers for attendance were linked to potential intervention options and the most promising behaviour change techniques. The step-by-step guiding process of the BCW permitted the development a clear framework to target attendance in inactive and low attenders' members of fitness centres. The selected BCTs facilitates the implementation and testing of this intervention framework in a specific fitness centre's setting.

Keyworkds: Behavior; COM-B Model; Leisure Centres; Physical Inactivity.

5.2. Introduction

The health-related benefits of doing regular physical activity (PA) in adults is well established (Lee et al., 2012, World Health Organization, 2020). Moreover, to be considered active, adults should perform 150-min of a combination of vigorous and moderate PA throughout the week and do two days of strength exercise of bigger muscle groups (World Health Organization, 2020). Nonetheless, the levels of physical inactivity (PIA; not meeting the international guidelines for PA) among modern societies was around 27·5% in 2016, and several regions like western countries in which the European Union (UE) is included evidenced a PIA prevalence of over 40% of their population (Guthold et al., 2018). This fact has led the WHO to set the challenge of reducing each country's 2010 prevalence of physical inactivity by 10% by 2025 and a further reduction of 15% from the 2016 prevalence level by 2030 (World Health Organization, 2013, World Health Organization, 2018a). However, the latest data available for the UE show that the prevalence of PIA increased by 3.6%

between 2013 and 2017 (Mayo et al., 2019), making PIA a prime target for behaviour change (Glanz and Bishop, 2010, Gourlan et al., 2016, Howlett et al., 2017, Murray et al., 2017, Olander et al., 2013).

Some research suggests that leisure-time physical activity (LTPA) is more beneficial for health than occupational PA (Byambasukh et al., 2020, Holtermann et al., 2012, Liu et al., 2018). Thus, as one of the main leisure-time exercise providers (Deloitte and EuropeActive, 2019, IHRSA, 2018), fitness and leisure centres might be very useful in delivering interventions promoting PA among low-active adults (Beedie et al., 2016, Lopez-Fernandez and Jiménez, 2018, Middelkamp et al., 2017). This view aligns with the authors of the latest Global Action Plan as they encourage policymakers to strengthen and enhance the fitness sector together with other sectors (Action 1.4 and Action 3.3) and combine them with other domains of PA (World Health Organization, 2018b).

Fitness centres offer their members many different unstructured and semi-structured PA options. Thus, PA interventions at these centres might be able to provide the participants with some kind of individualization (Annesi, 2003), instead of delivering the same intervention to everyone (Ogden, 2016). Moreover, as common places for adults to do PA, doing interventions at fitness centres provide the participants with a clear exit pathway to keep doing PA once the intervention is over (Lopez-Fernandez and Jiménez, 2018, Pavey et al., 2011). Additionally, the cost of the intervention might be partially or fully covered by the participants itself or an external entity (e.g., public body, insurance company, etc.) by the payment of the membership fee (Lopez-Fernandez and Jiménez, 2018, Verhoef et al., 2016). Therefore, trialling the intervention related to PA in the fitness centre have high ecological validity.

Despite these factors, monitoring fitness centres' members PA behaviour beyond the information coming from the access point is not easy (Clavel et al., 2020). So, it is not easy to know the PA prevalence of adults' members, despite recent research suggest that around 85% of the members of these centres self-report to be active (López-Fernández et al., 2021). Although attendance is not equal to PA, it is easier for fitness centres to track their members' attendance behaviour than their PA behaviour. Accordingly, it has been reported that the average attendance to fitness centres is around 1.1 to 5.6 exercise sessions per month (Clavel et al., 2016, Middelkamp et al., 2016). Furthermore, more than 60% of members might leave their centre within the first 12 months (Sperandei et al., 2019). Therefore, increasing the attendance behaviour at fitness centres might be more appropriate for future interventions in fitness centres than trying to increase PA behaviour (Annesi, 2003). This would result in an increase of the physical activity levels of these

individuals what has been related to relevant health benefits health even if they are unable to meet the international guidelines for physical activity (Mok et al., 2019). Furthermore, increasing the attendance rate of members of fitness centres might also reduce the likelihood of dropping out (Clavel et al., 2020).

5.3. Theory based intervention design

The Medical Research Council recommends interventions aiming to change specific behaviour to be designed according to a relevant theoretical framework because it increases its effectiveness (Craig et al., 2008). There are many different frameworks that can be incorporated to a behaviour change intervention; however, it is unknown which the most accurate and coherent approach to support changes related to public health behaviours (Gourlan et al., 2016, Michie et al., 2011). While no strong evidence exists in which framework is most promising to increase the attendance behaviour to fitness centres or any other PA service. A recent intervention has tried to support inactive members of fitness centres to regularly exercise in their centres by using the Transtheoretical Model (Stages of Change) (Middelkamp et al., 2017). However, it did not show a high rate of adherence to the suggested program so a different approach might be required.

The Behaviour Change Wheel (BCW) might be a coherent approach to increase the attendance behaviour among members of fitness centres because it synthetises nineteen psychological frameworks into a unique model that explains the main mechanisms involved in human behaviour. It was developed according to the COM-B Model theory (Michie et al., 2014), which is also recommended by the National Institute for Clinical Excellence (NICE) Guidance (National Institute for Health and Care Excellence, 2014). Moreover, the BCW has a step-by-step guideline that facilitates researchers or practitioners to identify the factors that might provide better support for the desired behaviour (Michie et al., 2014).

The BCW and the COM-B Model have proved to be valid to develop evidence-based interventions in the field of PA (Murtagh et al., 2018, Seppälä et al., 2018, Webb et al., 2016). So, they might work to target attendance at fitness centres although it is a different behaviour with probably different determinants. Chapter 4 displays the development of a questionnaire based on the COM-B Model to identify potential factors that might support members of fitness centres to increase their attendance behaviour. This questionnaire was specifically developed with physically inactive people and low fitness centre attenders. However, there remains the need for an intervention aimed to increase attendance rate of fitness centres' members in the literature. For

that reason, the objective of this research was to develop an intervention framework grounded in the BCW to increase attendance rates among fitness centres members as a way to improve their current levels of PA. In this research, those who exercise in their fitness centre less than 2 times/week in the previous month are classified as low attendance members (Gjestvang et al., 2019a, Gjestvang et al., 2019b, Pierce, 2018).

5.4. Intervention development methods and iterative results

5.4.1. Intervention development approach and frameworks

The intervention has been developed using the BCW guidelines and the Theoretical Domains Framework (TDF) (Atkins et al., 2017, Michie et al., 2014). To do so, a 2-phase process was followed (Figure 5). To reduce the risk of bias, an iterative approach of seven interactions was followed in the intervention development (Gould et al., 2017).

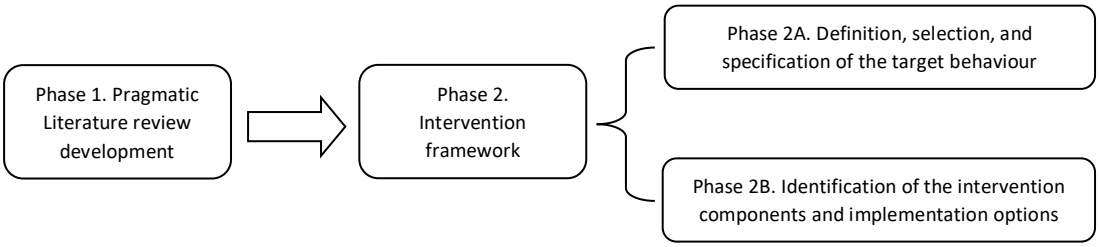

Figure 5. Phases for the development of the intervention framework

5.4.2. Phase 1. Pragmatic literature review

Several researchers suggest the use of a literature reviews to inform the different steps in the development of an intervention based on the BCW and to get a further understanding of the problem that wants to be addressed (Gould et al., 2017, Michie et al., 2014, Webb et al., 2016, Westland et al., 2017). In this case, a pragmatic literature review specific for this chapter was conducted to get further information on different topics: 1) factors that might contribute positively or negatively for the people to exercise in fitness centres; 2) factors used in intervention at fitness centres to support behaviour change (either PA behaviour or attendance behaviour); 3) the behaviour change techniques (BCTs) that have evidenced to be effective in promoting PA in clinical and non-clinical adults. In total 48 studies were included. Furthermore, the outcomes of this pragmatic literature review were used to develop a conceptual map with the main factors that somehow might play a role for members of fitness centres to exercise at their centres. The key

findings from the review are summarised in Table 8 while further description of the development of this intervention is displayed in the Appendix 7.

Table 8. Outcomes from the pragmatic literature review

Assessed topic	Findings		Studies' reference*
1) factors that might contribute positively or negatively for the people to exercise in fitness centres	➢ Number of bouts and time play a role in habit formation (i.e., 4 bouts/week for 6 weeks) ➢ Consistency, behaviour complexity, environment and affect play a role in habit formation. ➢ Staff's caring behaviour and support in achieving their objectives ➢ Task involving climate ➢ Reasons to exercise (Health, fitness, appearance, body building, training or competing, role model for children) ➢ Body image (appearance, Self-imagine), body composition ➢ Emotions: embarrassment, intimidation, boredom, enjoyment, simulated ➢ Gender spaces and gender norms, hyper-masculinized environments ➢ Type of membership, membership fee, financial reasons, free ➢ Quality of the service (parking, environment, services [cleanliness, equipment], staff, crowded problems) ➢ Customer delight and satisfaction ➢ Fulfilling the objectives for exercising ➢ Activities/programs characteristics and in line to customers interests and objectives ➢ Social interactions/support (friends, family, or staff) ➢ Length of membership (e.g., >6 months) ➢ Family/domestic time requirements/obligations ➢ Distance from fitness centres ➢ Exercise/program characteristics, lack of knowledge ➢ Use of the service (access average, duration of the stay) ➢ Time scheduling; Time availability; timetable of the centre ➢ Progresses, (not)fulfilment of objectives,		(Brown et al., 2017, Caudwell and Keatley, 2016, Clavel et al., 2016, Coen et al., 2018, DellaVigna and Malmendier, 2006, García-Fernández et al., 2018, Gazmararian et al., 2013, Gonçalves and Diniz, 2015, Jasinskas et al., 2013, Kaushal and Rhodes, 2015, Lagrosen and Lagrosen, 2007, MacIntosh and Law, 2015, Mazzuca et al., 2017, Middelkamp et al., 2016, Miller and Miller, 2010, Nuviala et al., 2013, Nuviala Nuviala et al., 2012, Oh et al., 2011, Pridgeon and Grogan, 2012, Theodorakis et al., 2014, Yi et al., 2020, Zarotis et al., 2017a, Zarotis et al., 2017b)
2) factors used in intervention at fitness centres to support behaviour change (either PA behaviour or attendance behaviour)	➢ Exercise plan provided (e.g., 3 bouts/week; cardiovascular exercise; weightlifting) ➢ Reinforcing the effect of the exercise experience (e.g., progress toward goals, improved mood, better self-image, increased vigour). ➢ Minimising unpleasant exercise experiences (e.g., fatigue, discomfort, perceived inadequacy) ➢ Controlling the exercise stimuli and adjusting it through the time. ➢ Provision of feedback (e.g., goal attainment, self-efficacy, affection) ➢ Self-management methods (e.g., goal setting, relapse prevention, dissociation, cognitive restructuring) ➢ Behavioural contracting ➢ Social support (non-familiar [staff, other participants]; familiar/friends; group or alone) and public recognition ➢ self-management/self-regulatory strategies (including, self-reward, self-reinforcement, cognitive restructuring, dissociation, self-efficacy, modelling expectations, etc.) ➢ Education and training under supervision on how to perform the exercise plan or how to exercise at fitness centre. ➢ Behavioural capacity Expectations ➢ Problem and barrier solving; gym membership (free); childcare, ➢ Incentives: economic (reward), motivational ➢ Time for going to the fitness centre to exercise ➢ Self-reported and objectively measured ➢ Consistency: schedule a fixed time of day to exercise ➢ Intention/coping planning		(Annesi, 2003, Arikawa et al., 2011, Crespin et al., 2016, Fisher et al., 2018, Foroughi et al., 2019, Kaushal and Rhodes, 2015, Kaushal et al., 2017, Middelkamp et al., 2017, Teychenne et al., 2015, Verhoef et al., 2016)
3) the behaviour change techniques (BCTs) that have evidenced to be effective in promoting PA in clinical and non-clinical adults	➢ Action planning ➢ Adding objects to the environment ➢ Barrier identification/problem-solving ➢ Behavioural practice/rehearsal ➢ Feedback on behaviour ➢ Feedback on outcome of behaviour ➢ Focus on past success ➢ Follow-up prompt ➢ Generalisation of target behaviour ➢ Goal setting ➢ Goal setting of behaviour ➢ Graded tasks ➢ Information on consequences of the behaviour in general ➢ Instruction on how to perform the behaviour	➢ Information on where and when to perform the behaviour ➢ Model/demonstrate the behaviour ➢ Monitoring goal progress ➢ Problem solving ➢ Prompt review of behavioural goals ➢ Provide instruction ➢ Reinforcing effort or progress towards behaviour ➢ Review of behaviour goals ➢ Rewards contingent on successful behaviour ➢ Self-monitoring ➢ self-monitoring of behaviour ➢ self-monitoring of behavioural outcome ➢ Social comparison ➢ Social support (general)	(Ashford et al., 2010, Avery et al., 2015, Bishop et al., 2015, Cradock et al., 2017, French et al., 2014, Muller-Riemenschneider et al., 2008, Murray et al., 2017, Rhodes and Pfaeffli, 2010, Samdal et al., 2017, Williams and French, 2011)

***** The full reference of the studies from the pragmatic literature review is in Appendix 7. **PA:** Physical activity

Figure 6 displays the developed conceptual map according to the pragmatic literature review. These factors were gathered based on their origin: fitness centres' members; the fitness centres; the staff and fitness instructors; family, friends, or home.

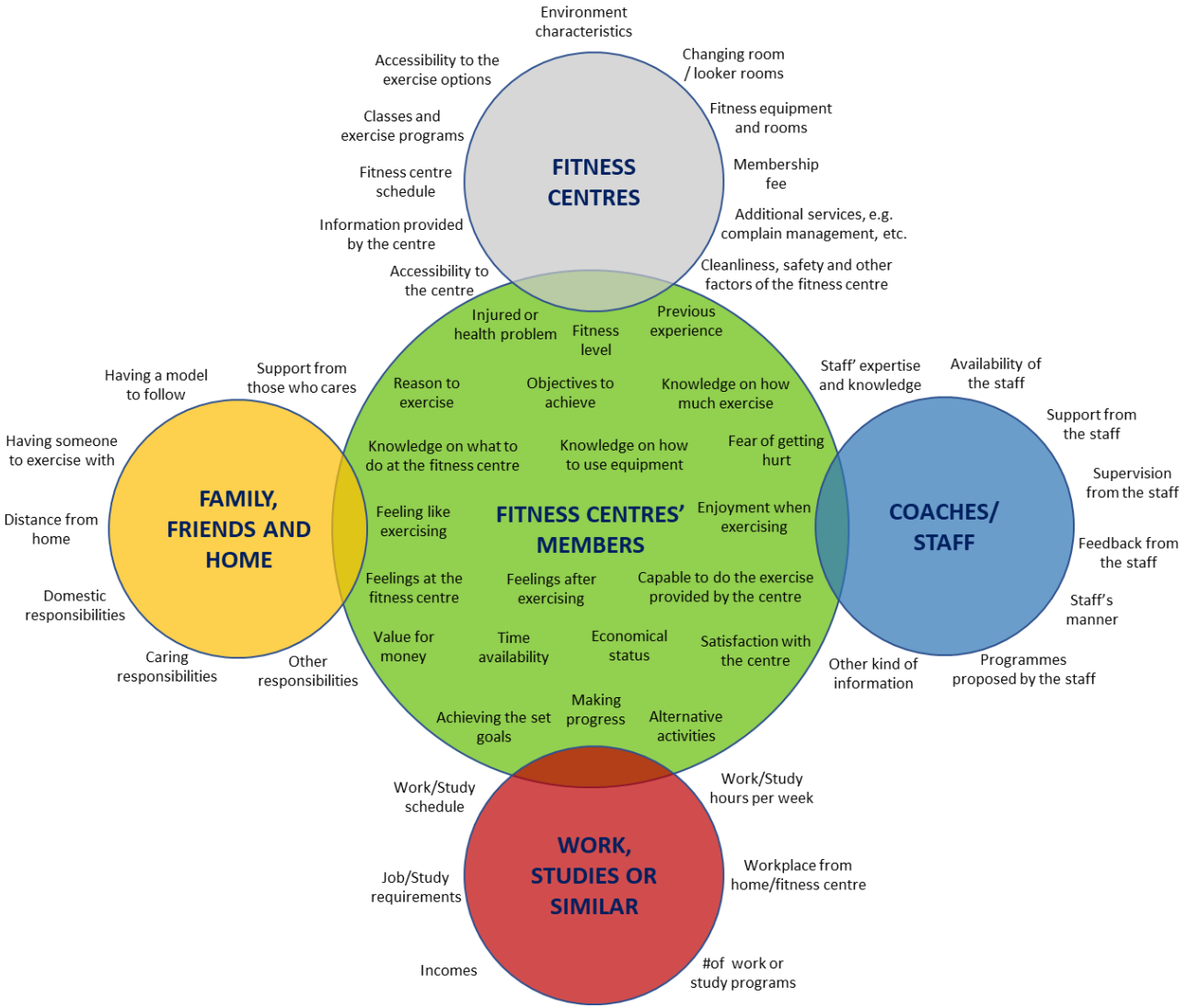

Figure 6: Main factors that somehow might play a role in people to attend to a fitness centre to exercise

5.4.3. Phase 2. Intervention development

The intervention was designed following the guidelines of the BCW, which divides the development of an intervention into three stages (Michie et al., 2014): 1) understand the behaviour; 2) identify the intervention options; 3) identify content and implementation options. Each of these stages is divided into steps that need to be completed to move to the following stage. Despite three phases are suggested by the BCW guidelines, to facilitate the development of the intervention all the process was completed into two phases. Phase 2A. described the definition, selection, and specification of the behaviour that is going to be targeted in this intervention. Phase 2B. described de identification of the factors that needs to be changed, the intervention options and the content and implementation options.

The main reasons for selecting the BCW as a framework to inform this intervention are: 1) the BCW is an intervention development framework, instead of a model of behaviour such as the theoretical Domains Framework (TDF), the TTP or the TBP (Michie et al., 2014, Michie et al., 2011); 2) there is a published systematic guideline that assists the researchers when using this framework to develop behaviour change information (Michie et al., 2014). Also, when this intervention was conceived and started, the TDF guidelines were not published yet (Atkins et al., 2017). Despite that, the TDF describes 14 factors from 33 theories of behaviour change, falls under the categories of Capability, Opportunity, and Motivation (Atkins et al., 2017, Michie et al., 2014). Therefore, both the BCW and the TDF can be combined to inform the components and guide the strategic decisions when designing behaviour change interventions (Michie et al., 2014). For that reason, both the BCW and the TDF were used in the development of the intervention presented in this chapter. All the decision-making processes from phases 2A and 2B were conducted using the APEASE criteria (affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects/ safety, and equity considerations) as suggested by the developers of the BCW guidelines (Michie et al., 2014). The outcomes from the literature review were also used to inform the decision-making process in the two phases that form the intervention development.

5.4.3.1. Iterative approach

First Interaction

The first author (JLF) first completed Phase 2A in order to create an initial draft in which the selected behaviour was defined and specified accordingly to the guidelines.

Second iteration

The second author (LA) provided a full revision of the initial draft and together with the JLF completed a second version of Phase 2A.

Third iteration

The latest author (EH) conducted a new revision of the Phase 2A and together with the JLF and LA developed the final version for Phase 2A. All disconformities were discussed until a full consensus was achieved.

Fourth iteration

JLF with the help of LA completed the draft for Phase 2B in which described all the followed process in the identification of the intervention options as well as the content and implementation options. All disconformities were discussed until a full consensus was achieved.

Fifth iteration

LA provided a full revision of the draft for Phase 2B and together with JLF and LA completed a second version of Phase 2A.

Sixth iteration

EH conducted a new revision of the Phase 2A and together with the JLF and LA developed the final version for Phase 2A. All disconformities were discussed until a full consensus was achieved.

Seventh interaction

All the co-authors of this work completed a full review of the development of this intervention, and all together developed the final version. All disconformities were discussed until a full consensus was achieved.

5.4.3.2. Phase 2A. definition, selection, and specification of the target behaviour

5.4.3.2.1. Methods

Phase 2A encompass the first three steps of the BCW (Step 1. Definition of the problem in behavioural terms. Step 2. Selection of the target behaviour; Step 3. Specification of the Target

Behaviour), which were completed simultaneously according to the step-by-step guide of the BCW and supporting the decisions based on the outcomes from the pragmatic review and existing evidence (Michie et al., 2014). Furthermore, the specification of the target behaviour was defined in detail by using the questions suggested in the guidelines of the BCW (Michie et al., 2014): Who needs to perform the behaviour? What does the person need to do differently to achieve the desired change? When will they do it? Where will they do it? How often will they do it? With Whom will they do it?

5.4.3.2.2. Results

The literature review revealed that targeting PIA at fitness centres is hard due to factors like the low attendance rate (1.1 to 5.6 times/month), the high dropout levels (>60% within the first 3 months), and the difficulties for monitoring PA levels of the members through the week (Annesi, 2003, DellaVigna and Malmendier, 2006, Middelkamp et al., 2016, Sperandei et al., 2016, Sperandei et al., 2019). It also showed that there is very low information on the PA levels of members of fitness centres and the number of inactive members (Kaushal et al., 2017, Mazzuca et al., 2017, Middelkamp et al., 2017, Miller and Miller, 2010). Also, there is a lack of knowledge of the main barriers and limitations of exercising at fitness centres, although some studies have contributed to this gap (Coen et al., 2018, Kaushal et al., 2017, MacIntosh and Law, 2015, Middelkamp et al., 2016, Zarotis et al., 2017b). In contrast, the analysis of attendance rate of fitness centres has been more studied, and evidence show most members show a low average attendance rate (Clavel et al., 2020, Gonçalves and Diniz, 2015, Middelkamp et al., 2016, Nuviala et al., 2013, Yi et al., 2020). The findings from this studies suggest that attendance might be a more feasible behaviour to target at fitness centres because it is easier to be monitored (e.g., through the access point to the centre), it is easier for implementation, it has the potential to increase the PA levels of the participants and the fitness industry is likely to be interested in take part in the implementation of interventions targeting this behaviour (Clavel et al., 2020, Lopez-Fernandez and Jiménez, 2018, López-Fernández et al., 2021). Thus, attendance was the selected behaviour for this intervention.

Despite attendance seems to be a more feasible behaviour than PIA, the pragmatic literature review revealed that exercising at a fitness centre is influenced by at least four groups of factors (Figure 6): I.e., domestic/social (Family, friends, and home); occupational (Work/studies and similar); staff (coaches, any other fitness staff); the fitness centre itself. Therefore, attendance is also a complex behaviour in which many factors can be decisive, although only those manageable by fitness centres were considered in this intervention. Furthermore, enhancing attendance behaviour

as a way to increase the PA levels is complex and depends on multiple behaviours which need to be also considered:

- Enrol at the fitness centre.
- Go to the fitness centre to do PA/exercise.
- Wear the appropriate clothes for exercising (might include using the changing room).
- Have some level of planning or objective of what to do at the fitness centre.
- Complete partially/fully the planned exercise and maybe some unplanned exercises.
- Repeat these behaviours with some regularity (X number of times per unit of time [i.e., weeks and / or months]).

The definition of the target behaviour (Step 3) according to the guidelines of the BCW is displayed in Table 9.

Table 9. What needs to be considered to specify the target behaviour (Engaging in regular exercise within the fitness centre)

Factors to consider	Characteristics of these factors
Who needs to perform the behaviour?	Low-attendance members (less than two times/week; (Gjestvang et al., 2019a, Pierce, 2018) of fitness centres reporting to be inactive are the population who can benefit the most from increasing their attendance behaviour. However, active-low-attendance members whose METs/week are mainly due to walking activities can also benefit from this intervention (Mazzuca et al., 2017).
What does the person need to do differently to achieve the desired change?	The person has to attend the fitness centre to do PA two or more times per week
When will they do it?	Every week
Where will they do it?	Within the fitness centre (the exact location has to be specified for each day or exercise type to be performed)
How often will they do it?	Every week
With Whom will they do it?	Alone or in group. It can be supervised by a fitness instructor whenever needed.

5.4.3.3. Phase 2B. Identification of the factors that needs to be changed, the intervention options and the content and implementation options

5.4.3.3.1. Methods

Phase 2B encompass the remaining steps of the BCW *(**Step 4. Identification of what needs to be changed; Step 5. Intervention options; Step 6. Policy categories; Step 7 Identify the behaviour change techniques; and, Step 8. Identify Mode of Delivery***).

The identification of what needs to be changed was completed using the COM-B Model as suggested in the guidelines (Michie et al., 2014). To do so, this intervention used the 17-items questionnaire named Determinants of Attendance Rates in Fitness Centres (DARFC) developed in

Chapter 4 as it showed acceptable validity. The process of identification of these factors is described in Chapter 4 so it is not explained here. The reason to use this questionnaire is that it identifies 17 factors behind attendance behaviour and permits to reduce of the elements to target in the intervention to focus only on those that seem to be more promising. Furthermore, this questionnaire was developed in a way that permits the use of the TDF to inform the intervention component, the content and implementation options for each of the 17 items identified in the DARFC questionnaire (Atkins et al., 2017, Michie et al., 2014). Despite these reasons supporting the use of this questionnaire, it is important to acknowledge its limitations (see chapter 4) as well as the complexity of the COM-B Model (Michie et al., 2014, Michie et al., 2011). For that reason, future studies might consider assessing the validity of this questionnaire in their population before using it. A 35-items questionnaire was initially developed in chapter 4 with acceptable content validity, but it was not used here because it did not show acceptable construct validity.

Regarding the intervention components, only the intervention options were defined and selected in this intervention. Policy categories were not selected because we acknowledge that practitioners and researchers might not have the possibility of modifying this level in some fitness centres. The intervention components were defined using the Behaviour Change Techniques taxonomy V1 (BCTs) (Michie et al., 2013). For each of these BCTs at least one mode of deliver was identified. Moreover, an example of how deliver these BCTs was defined.

The selection of the TDF domains, the intervention functions, the BCTs and the mode of deliver for each of the 17-items of the DARFC questionnaire was completed using the APEASE criteria and the outcomes from the pragmatic literature review (Michie et al., 2014). Furthermore, they were selected considering the possible responses of future participants when responding the DARFC questionnaire.

On the other hand, the identification of the BCTs and the mode of deliver have been completed considering fitness centres' instructors can be part of the intervention. This is because these instructors are part of the resources of fitness centres and might be needed in delivering some BCTs or monitoring some progress. However, it is acknowledged that the implication of instructors might be challenging. For that reason, additionally, an analysis of potential barriers that fitness instructors might have to delivering the intervention have been conducted. The objective of this analysis was to inform on some potential barriers or elements that might exist when involving fitness centre instructors in this intervention. Nonetheless, these barriers might change from one centre to another. The identification of these barriers was conducted through a one-to-one interview with

fitness instructors. Firstly, a convenience sample of 3 fitness instructors with 8.2 ± 1.33 years of experience from two fitness centres was recruited. Using a snowball approach (each initial instructor invited three instructors) the initial sample was increased until saturation was achieved. In total, 7 instructors were interviewed (7.88 years ± 1.36 years). All interviews were conducted by the author of this doctoral thesis face to face. Interviews started with an explanation of this chapter's (chapter 5) objective and main characteristics. Also, participants were shown a draft of the intervention framework to increase the attendance rate among fitness centres members that have been developed in this chapter. After that, they were asked to discuss how comfortable they would feel if they had to be part of the delivery of this intervention, the motivations to participate and how this intervention would affect their jobs. Interviews lasted for 12 min ± 2 min (Explanation of the intervention and doubts = 8 min ± 2 min; participants' responses/comments = 4 min ± 1 min). Interviews were audio-recorded and transcribed (Appendix 8). Finally, using thematic analysis (Braun and Clarke, 2012) potential barriers were identified and gathered according to the main three constructs of the COM-B Model (Table 10). The identified barriers are related to lack of understanding, lack of time, lack of resources or lack of interest in being part of the intervention.

Table 10. Staff member's barriers to BCT intervention delivery within the COM-B Framework (Michie et al., 2014)

BCTs: Behaviour change technique (taxonomy V1) (Michie et al., 2013)

5.4.3.3.2. Results

The TDF domains, the intervention functions, the BCTs and the mode of deliver for each of the 17-items of the DARFC questionnaire is displayed in Table 11. Accordingly, the first column represents the barrier or determinant for attendance identified in the 17-items questionnaire developed in Chapter 4. The second column links the questionnaire item with the corresponding component of the TDF. The third column encompass the possible responses of the questionnaire. Each possible response is connected to the corresponding intervention function (fifth column). Sixth column displays the most promising BCTs to target the identified determinant while the seventh column shows how these BCTs can be delivered. These BCTs were selected using the APEASE criteria and the outcomes from the literature review. This review was used to identify some promising BCTs to promote PA among non-clinical adults, as well as some elements that might play a significant role in attending or not fitness centres (Table 8). Finally, the eighth column contain an example of how to deliver each identified BCTs in a fitness centre setting.

Table 11. TDF domains, intervention functions, BCTs, mode of deliver the BCTs and an example for delivering the BCTs for each of the 17-items of the DARFC questionnaire

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Example of how to provide the BCT	Mode of delivery and examples of the delivery
	RM2: I am willing to make changes to exercise more and/or be active at my leisure centre	Intention	Agree / Totally agree	Incentivisation	**1.9.** Commitment Or (*If the person failed in meeting his commitment)* **1.8.** Behavioural contract	**BCT 5.1.** Explain the benefits of physical activity and consequences of engaging in an inactive behaviour (it is not required to explain all). **BCT 1.9.** Ask the person to affirm and/or reaffirm statements indicating he/she is going to ➢ Meet a minimum of exercise trainings per week ➢ Make the required changes (the person must explain what is going to change) ➢ Follow the exercise programme **BCT 1.8.** The person has to sign or accept (in an app) the following commitments ➢ Minimum of exercise trainings per week ➢ Follow the exercise programme **BCT 13.1.** Inform that the behaviour of the person may be example for others that person cares about (i.e. children, partner, etc.)	**BCTs 5.1. and 13.1** **Face-to-face** *(individual [By the staff])* ➢ In an initial meeting between the staff and the person ➢ In future meetings **Distance** ➢ *Individual level* o Messages through App o Messages through email ➢ *Population level* o Signs at the fitness centre o Audio messages at the fitness centre; etc. **BCTs 1.9.** **Face-to-face** *(individual [By the staff])* ➢ In an initial meeting between the staff and the person ➢ In future meetings **BCT 1.8.** **Face-to-face** *(individual [By the staff])* ➢ In an initial meeting between the staff and the person ➢ In future meetings **Distance** *(individual level)* ➢ Using a mobile App to sign the agreement ➢ Sending a sign email to the fitness centre (the email has to be attached in the personal profile)
			Neither Agree / Disagree	Persuasion + Incentivisation	**5.1.** Information about health consequences + **1.9.** Commitment /or **1.8.** Behavioural contract		
			Disagree / Totally disagree	Persuasion + Coercion	**5.1.** Information about health consequences + **1.8.** Behavioural contract		
	RM5: Having a programme that guides me on how to exercise at my leisure centre is important to me	Intention	Agree / Totally agree	Enablement	**1.4.** Action planning + **1.8.** Behavioural contract	**BCT 1.4.** ➢ Add to the exercise plan (RM4) a complete exercise programme that must include the exercise to perform, duration, intensity, etc. **BCT 1.9. or BCT 1.8.** ➢ Select the BCTs depending on the response in RM2 ➢ The commitment or behaviour contract must include meeting the arranged exercise plan	**BCT 1.4.** **Face-to-face** *(individual [By the staff])* ➢ Arrange the exercise programme together with the staff member **Distance** *(individual level)* ➢ Using a mobile App or an online platform to o Guarantee the person can check his/her exercise programme anytime o To modify the current exercise programme
			Neither Agree / Disagree	Enablement	**1.4.** Action planning + **1.9.** Commitment /or **1.8.** Behavioural contract		
			Disagree / Totally disagree	N/A	N/A	N/A	N/A
	RM7: It is important for me to receive feedback from my leisure centre about how my health and fitness are improving	Behavioural regulation	Agree / Totally agree	Incentivisation	* Add the BCTs **2.1.** and/or **2.2.** and/or **2.5.** and/or **2.7**	**BCT 8.1.** Using the following tools to monitor the behaviour ➢ Monitoring the access to the centre ➢ Monitoring the classes that the person assists **BCT 2.2.** ➢ Inform of the degree of compliance with the committed/agreed behaviour **BCT 2.5.** ➢ Monitoring health data (body composition, estimated VO2, etc.). **BCT 2.7.** ➢ Inform of the improvements achieve ➢ Inform of the amount of exercise completed (In Mets, Kcal, etc.) **** Apply BCTs 2.1. and 2.5. Whenever possible**. It is important to ➢ Provide feedback on behaviour or outcomes in future (**2.2. or 2.7. or 1.6.)** ➢ To know the degree of compliance (commitment or behavioural contract; RM2). ➢ To know if the person's objectives, plan or objectives are being fulfilling ➢ To assess the effectiveness of the intervention	**BCT 2.1.** **Distance** *(individual level)* ➢ Using an online platform to monitor the access ➢ Using an online platform or mobile app to monitor the booked classes **BCT 2.5.** **Distance** *(individual level)* ➢ Using wearables, tests completed by the person itself, etc. to monitor improvements and outcomes ➢ Asking the person to complete voluntary tests or questionnaires **BCTs 2.2. and 2.7.** **Face-to-face** *(individual [By the staff])* ➢ The staff provide the feedback to the person **Distance** *(individual level)* ➢ Sending push or emails to the person ➢ Recording everything in the person's profile and allow the person to gain access to his/her profile to see the outcomes
			Neither Agree / Disagree	Incentivisation	Explaining why monitoring may be important. * ***If accepted***: Add the BCTs **2.1.** and/or **2.2.** and/or **2.5.** and/or **2.7** ** ***If rejected:*** Avoid the BCTs **2.2.** and/or **2.7.** But keep BCTs **2.1.** and/or **2.5.**		
			Disagree / Totally disagree	N/A	Avoid the BCTs **2.2.** and/or **2.7.** But keep BCTs **2.1.** and/or **2.5.**		

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Example of how to provide the BCT	Mode of delivery and examples of the delivery
Automatic Motivation	**AM1:** I don't feel like going to my leisure centre to exercise	Emotion	Agree / Totally agree	Persuasion	**1.4.** Action planning /or **4.1.** Instruction on how to perform the behaviour + **8.3.** Habit formation Or **8.4.** Habit reversal + (*If required*) **7.1.** Prompts/cues	**BCT 8.3.** Agreed with the person a new habit to follow (if frequency or duration is set; also, **BCT 1.4.**); (If an old habit is modified; Also, **BCT 8.4**) ➢ Wake ap earlier to exercise before going to work ➢ Prepare in advance the clothes for exercising **BCT 8.4.** ➢ After work, instead of going home go to the fitness centre ➢ Going to the gym while his/her son are doing an extracurricular activity **BCT 1.4.** Agree a plan with the person to go to the fitness centre and exercise even though the person does not feel like to exercising. The plan needs to include at least ➢ ***Frequency***: Plan when the person is going to go to the fitness centre to exercise (i.e. every Monday and Wednesday) ➢ ***Duration:*** Exercise in the gym xx minutes a day/ a week **BCT 4.1.** If the staff provide advise but a plan is not arranged ➢ When planning to exercise, go straight to the fitness centre **BCT 7.1.** Advice the person to set a stimulus to remind going to the fitness centre ➢ Set a specific alarm to recall the planned exercise to do ➢ Leave the backpack for the fitness centre in the entry so the person recalls going to the fitness centre instead of staying at home.	**BCTs 1.4. and 4.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff member provides the person with the instruction or the plan to follow. **Distance** *(individual level)* ➢ Using a mobile App or an online platform to o The instruction to follow or plan is available in the person's profile so he/she can check it anytime **BCTs 8.3., 8.4.** **Face-to-face** *(individual [By the staff])* ➢ The staff member arranges together with the person the new behaviour to follow. **Distance** *(individual level)* ➢ Using a mobile App or an online platform to o Allow the person to check the new behaviour that have to do **BCT 7.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff provides tips to the person to set her/his own prompts/cues. **Distance** *(individual level)* ➢ Using a mobile App or an online platform to provide a prompt
			Neither Agree / Disagree	Persuasion	**1.4.** Action planning /or **4.1.** Instruction on how to perform the behaviour + **8.3.** Habit formation Or **8.4.** Habit reversal + (*If required*) **7.1.** Prompts/cues		
			Disagree / Totally disagree	N/A	N/A	N/A	N/A
	AM2: Exercising at my leisure centre is boring for me	Emotion	Agree / Totally agree	Persuasion	**1.4.** Action planning + *(if required)* **8.3.** Habit formation	**BCT 1.4.** Set a dynamic exercise programme to follow so the person may enjoy. ➢ Avoid too much endurance exercise alone or endurance training divided into set and reps. ➢ Suggest following a dynamic training (i.e. circuit training, HIIT, classes, etc.) ➢ Duration of the exercises or frequency, or intensity must be arranged to deliver this BCT **BCT 4.1.** If the staff provide advice about training (i.e. classes, HIIT, circuit training, etc.) but a plan is not arranged. Or when provide an instruction to support the habit formation **BCT 8.3.** Prompt the person to follow a behaviour when exercising ➢ Wearing personal headphones to listen to a podcast; person's favourite music; the radio ➢ Creating a routing for completing the exercise programme so they always follow the same steps.	**BCTs 1.4. and 4.1.** **Face-to-face** *(individual [By the staff])* ➢ Providing the person with the instruction or the plan to follow. **BCTs 8.3., 8.4.** **Face-to-face** *(individual [By the staff])* ➢ The staff member prompt the person to follow the set instruction or plan
			Neither Agree / Disagree	Persuasion	**4.1.** Instruction on how to perform the behaviour + *(if required)* **8.3.** Habit formation		
			Disagree / Totally disagree	N/A	N/A	N/A	N/A
	PsC3: It is important for me to self-monitor how much exercise I do at my leisure centre	Behavioural regulation	Agree / Totally agree	N/A	**BCTs 2.3** Self-Monitoring of behaviour + (if possible) **BCT 2.4.** Self-monitoring outcomes of behaviour	**BCT 2.3.** The person self-monitor his behaviour ➢ Validating the days, he/she goes to the fitness centre ➢ Validating the exercises, he/she has completed in any visit to the centre **BCT 2.4.** The person self-monitor his progresses ➢ Health data (i.e. weight lost) Self-record/register the outcomes performed (i.e. Kcals expended; Time in the gym; etc.)	**BCT 2.3.** **Distance** *(individual level)* ➢ Using a mobile application **BCT 2.4.** **Distance** *(individual level)* ➢ Using a mobile application ➢ Using some wearables to self-monitor and transfer the data to the mobile app Completing self-reported questionnaires or tests
			Neither Agree / Disagree	Education	Explaining why self-monitoring may be important. * ***If accepted***: Add the BCTs **2.3** or **2.4** ** ***If rejected:*** Avoid the BCTs **2.3** and **2.4**		
			Disagree / Totally disagree	N/A	** Avoid the BCTs **2.3** and **2.4**	N/A	N/A

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Mode of delivery	Example of the delivery
Social Opportunity	**SO1:** The people that matter to me (my family circle/close friends/partner) are supportive of me exercising at my leisure centre	Social influences	Agree / Totally agree	N/A	N/A	N/A	
			Neither Agree / Disagree	Modelling	**13.1.** Identification of self as role model	**BCT 13.1.** Inform that the behaviour of the person may be example for others that person cares about (i.e. children, partner, etc.) **BCT 5.2.** Emphasise how engaging in regular physical activity will affect the life of the person (it is not about health consequences) ➢ They can play with their children ➢ They will be more dependent when aging so they will need less external support ➢ They can enjoy exercise activities with not much effort.	**BCTs 5.2. and 13.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff member informed the person about how being a role model or about the salience of consequences. **Distance** ➢ Individual level o Pushes through the APP, email, etc. ➢ Collective level o Slogans around the facility o TV advertisings within the centre o Audio slogans
			Disagree / Totally disagree	Modelling + Education	**5.2.** Salience of consequences + **13.1.** Identification of self as role model		
	SO2: If I wanted to, I can exercise with others at my leisure centre	Social influences	Agree / Totally agree	N/A	N/A	N/A	
			Neither Agree / Disagree	Environmental restructuring	* Information about the available classes	*** Information about the available classes:** Explain the classes available, what are they about, and the available levels (if existing). Tips or suggestions can be also given **BCT 12.1.** Encourage the person to exercise with a friend / relative [It can be supported by a familiar fee, friendship fee])	**BCTs 12.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff member informed about the classes ➢ The staff suggest the person to exercise with a friend/relative. **Distance** *(Individual level)* ➢ Individual level o Pushes through the APP, email, etc.
			Disagree / Totally disagree	Environmental restructuring	* Information about the available classes + **12.2.** Restructuring the social environment		

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Mode of delivery	Example of the delivery
Physical Opportunity 1	**PO5:** I can book classes or other kinds of exercise services in advance if I want to	Environmental context and resources	Agree / Totally agree	N/A	N/A	N/A	
			Neither Agree / Disagree	Environmental restructuring	**** if services cannot be booked in advance*** **12.1.** Restructuring physical environment ***** If services can be booked in advance*** **4.1** Instruction on how to perform the behaviour + / or **12.1.** Restructuring physical environment	***If services cannot be booked in advance***: **BCT 12.1.** The centre should consider getting an app or platform to provide this service to the people ***If services are booked in advance***: **4.1.** Explain the person how to book the classes or other exercise services in advance **BCT 12.1.** Review the process to see if un update can be done to facilitate this process	**BCTs 4.1.** **Face-to-face** *(individual [By the staff])* ➢ Providing the person with the instruction to follow **Distance** *(individual [online])* ➢ Upload the instruction on an online platform so the person can check them anytime **BCTs 12.1.** **Distance** *(collective level)* ➢ The restructuring is available online for everyone
			Disagree / Totally disagree	Environmental restructuring	**** if services cannot be booked in advance*** **12.1.** Restructuring physical environment ***** If services can be booked in advance*** **4.1** Instruction on how to perform the behaviour + / or **12.1.** Restructuring physical environment		
	PO6: There are classes available or other exercise options ranked by intensity and difficulty so I can take part in them regardless of my fitness level or ability	Environmental context and resources	Agree / Totally agree	Environmental restructuring And / or Enablement	****If classes are not available for levels*** **12.1.** Restructuring physical environment + / or **1.4.** Action Planning ***** If classes are available for levels*** Explain the levels' demands and which level is more appropriate for the person + **1.4.** Action Planning	***If classes are not available for levels*** **BCT 12.1.** The centre should consider add some classes at different level **BCT 1.4.** Arrange or provide the person with an exercise programme according to the level of the person ***If classes are available for levels*** **BCT 4.1.** Explain the levels' demands and inform the person which level is more appropriate for her/him **BCT 12.1.** Review the process to see if un update can be done to provide more levels or more offers per level	**BCTs 4.1.** **Face-to-face** *(individual [By the staff])* ➢ Providing the person with the instruction to follow **Distance** *(individual [online])* ➢ Upload the instruction on an online platform so the person can check them anytime **BCTs 12.1.** **Distance** *(Collective level)* ➢ The restructuring is available for evreyone
			Neither Agree / Disagree	Environmental restructuring And / or Enablement	****If classes are not available for levels*** **12.1.** Restructuring physical environment + / or **1.4.** Action Planning ***** If classes are available for levels*** **4.1** Instruction on how to perform the behaviour or **1.4.** Action Planning		
			Disagree / Totally disagree	N/A	N/A	N/A	
			Neither Agree / Disagree	Enablement	**4.1.** Instruction on how to perform the behaviour + **12.1.** Restructuring physical environment		
			Disagree / Totally disagree	N/A	N/A	N/A	

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Mode of delivery	Example of the delivery
	PO8: If required, my leisure centre provides me with a tailor-made programme to follow	Environmental context and resources	Agree / Totally agree	N/A	N/A	N/A	
			Neither Agree / Disagree	Enablement	N/A	*** If the centre does not provide the person with a tailor-made programme** ➢ Support the person participating in the intervention with a tailor-made programme (whenever required) *** If the centre provides the person with a tailor-made programme** ➢ Review if improvements can be done to facilitate this process ➢ Explain the person how he/she can get the exercise programme	N/A
			Disagree / Totally disagree	Enablement	N/A		
	PO10: Staff at my leisure centre are able to advise me about exercising there	Environmental context and resources	Agree / Totally agree	N/A	N/A	N/A	N/A
			Neither Agree / Disagree	Enablement	N/A	N/A	
			Disagree / Totally disagree	Enablement	N/A	N/A	
	PO11: I can't get help or supervision from staff when I need it	Environmental context and resources	Agree / Totally agree	Enablement	**4.1.** Instruction on how to perform the behaviour	**BCT 4.1.** Prompt / encourage the person to go directly to an available staff and asking for supervision anytime he/she need it	
			Neither Agree / Disagree	Enablement	**4.1.** Instruction on how to perform the behaviour		
			Disagree / Totally disagree	N/A	N/A	N/A	

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Mode of delivery	Example of the delivery
Physical Capability	**PhC1:** I do not have any health condition or illness that keeps me from exercising at my leisure centre	Skills	Agree / Totally agree	N/A	N/A	N/A	N/A
			Neither Agree / Disagree	N/A	N/A * Medical assessment or/and assessment by an expert in physical conditioning to guarantee the person can exercise	N/A	N/A
			Disagree / Totally disagree	N/A	N/A * Medical assessment to guarantee the person can exercise	N/A	N/A
			Neither Agree / Disagree	Training	**8.7.** Graded Task + (*If required*) **1.4.** Action Planning + **8.3.** Habit formation Or **8.4.** Habit reversal + (*If required*) **7.1.** Prompts/cues		
			Disagree / Totally disagree	N/A	N/A	N/A	N/A

COM-B domain	Items	TDF Domains	Response in the questionnaire	Intervention functions	Behaviour Change Technique	Mode of delivery	Example of the delivery
Psychological Capability	**PsC4:** I do not know how to safely use the equipment at my leisure centre	Knowledge	Agree / Totally agree	Education	**BCT 4.1** Instruction on how to perform the behaviour or/+ **BCT 6.1.** Demonstration of the behaviour or/+ **BCT 8.1** Behaviour practical/rehearsal	**BCT 4.1.** ➢ Explain the person how to do use the equipment of the centre **BCT 6.1.** ➢ Provide the person visual demonstration of how to use the equipment **BCT 8.1.** ➢ Ask the person to use the equipment under the supervision of a staff member to guarantee he/she has learned how to use it	**BCTs 4.1. and 8.1** **Face-to-face** *(individual [By the staff])* **BCT 6.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff use the equipment. ➢ Other person performs uses the equipment whilst a staff member provides the required explanations **Distance** *(individual level)* ➢ Using a mobile application; videos; etc.
			Neither Agree / Disagree	Education	**BCT 4.1** Instruction on how to perform the behaviour or/+ **BCT 6.1.** Demonstration of the behaviour or/+ **BCT 8.1** Behaviour practical/rehearsal		
			Disagree / Totally disagree	Education	Check with the person if he/she really knows how to use the equipment * ***If not***: Add the BCTs **4.1** or/and **8.1**		
	PsC5: I do not know how to do the exercises included in my programme	Knowledge	Agree / Totally agree	Education	**BCT 4.1** Instruction on how to perform the behaviour or/+ **BCT 6.1.** Demonstration of the behaviour or/+ **BCT 8.1** Behaviour practical/rehearsal	**BCT 4.1.** ➢ Explain the person how to do the exercise from his/her programme **BCT 6.1.** ➢ Provide the person visual demonstration of how to do the exercises of his/her programme **BCT 8.1.** Ask the person to exercise under the supervision of a staff member to guarantee he/she has learned how to do the exercises of his/her programme	**BCTs 4.1. and 8.1** **Face-to-face** *(individual [By the staff])* **BCT 6.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff perform the exercises. ➢ Other person performs the exercises whilst a staff member provides the required explanations **Distance** *(individual level)* ➢ Using a mobile application; videos; etc.
			Neither Agree / Disagree	Education	**BCT 4.1** Instruction on how to perform the behaviour or/+ **BCT 6.1.** Demonstration of the behaviour or/+ **BCT 8.1** Behaviour practical/rehearsal		
			Disagree / Totally disagree	Education	Check with the person if he/she really knows how to do the planned exercises * ***If not***: Add the BCTs **4.1** or/and **8.1** ** ***If so:*** Avoid the BCTs **4.1** and **8.1**		
	PsC6: I do not understand how the exercises in my programme can help me to improve my fitness	Knowledge / Beliefs about consequences	Agree / Totally agree	Education	If required check the person's exercise programme * ***New programme required***: add **BCT 1.4** Action planning + Explanation about how the programme will help the person to achieve the set goals ** ***The programme is fine:*** Explanation about how the programme will help the person to achieve the set goals	**BCT 4.1.** ➢ Provide the person with a new exercise programme + Explanation about how the programme will help the person to achieve the set goals	**BCT 6.1.** **Face-to-face** *(individual [By the staff])* ➢ The staff make the exercise programme for the person **Distance** *(individual level)* ➢ The exercise programme is available in a mobile App so the person can check it any time she/he needs ** The explanation about how the programme will help the person to achieve the set goals is given face to face
			Neither Agree / Disagree	Education	If required check the person's exercise programme * ***New programme required***: add **BCT 1.4** Action planning + Explanation about how the programme will help the person to achieve the set goals ** ***The programme is fine:*** Explanation about how the programme will help the person to achieve the set goals		
			Disagree / Totally disagree	N/A	N/A	N/A	

5.5. Discussion

This is the first work that describes the systematic development of an intervention framework to increase attendance among members of fitness centres as a way to promote PA. Those members reporting low levels of PA (Inactive) and have an attendance rate lower than 2 times/week were identified as the main beneficiary of this intervention. The BCW was followed in development of this intervention (Michie et al., 2014). While both the BCW guidelines and the TDF were used to inform intervention components, the taxonomy of Behaviour Change Techniques (BCTv1) and the most appropriate behaviour change strategies (Atkins et al., 2017, Michie et al., 2014).

The BCW and the TDF have been previously used to develop PA programs and intervention in other PA areas such as PA of the Canadian population (Truelove et al., 2020), the PA levels of mothers and teenage daughters (Murtagh et al., 2018) or PA levels at the workplace (Munir et al., 2018). Yet, these frameworks have not been used to develop a behaviour change intervention targeting attendance of fitness centres' members as a way to improve their PA levels. As reported by other authors, the use of the BCW to develop a framework for a behaviour change intervention is a time-consuming process to identify what need to change in terms of COM-B to perform the target behaviour and to select the most appropriate intervention functions, policy categories and BCTs (Murtagh et al., 2018, Webb et al., 2016). However, the step-by-step guiding process was used to systematically describe all the decision-making process what facilitates both comparisons among interventions and future replications (Michie et al., 2014).

The use of pragmatic literature review to inform an intervention framework based on the BCW and TDF has been used in previous studies (Gould et al., 2017, Webb et al., 2016, Westland et al., 2017). In this case, it helped to specify the target behaviour and to inform the most promising intervention components and BCTs for targeting each determinant/barrier identified in the 17-items questionnaire. Furthermore, an example of how to deliver the identified BCTs considering fitness centres' setting was provided. This information can be used to inform the development and application of an intervention content in a specific fitness centre's setting to increase attendance rate of inactive-low-attenders' members. Furthermore, fitness centres' managers can use this study to modify some setting of their centres in order to overcome some of the identified attendance barriers.

On the other hand, it is important to acknowledge the limitations of the 17-items questionnaire used to develop this intervention (Chapter 4). This questionnaire derives from a 35-item questionnaire that might include some other promising elements that affect attendance at fitness centres. However, contrary to the 35-items questionnaire, the 17-items questionnaire showed acceptable content and construct validity, so this fact supports its use in this intervention (Brown, 2014, Hair Jr et al., 2016, Malhotra and Dash, 2011). Future studies might consider validating the 17-items questionnaire in their target population or even test if a different model derives from the original 35-items questionnaire (Fernández-Martínez et al., 2020).

5.6. Limitations, strengths and implications for practice and future research suggestions

Despite the step-by-step approach for developing this intervention framework, there are some limitations that need to be acknowledged. (a), the intervention framework has not been pilot tested so its applicability and effectiveness remain unknown. (b) Furthermore, each fitness centre is different in nature and characteristics and might not be able to deliver all the identified BCTs. (c) The implementation of this intervention framework requires the practitioners and researchers to create a specific content according to the fitness centre's settings the intervention is going to be applied. (d) The DARFC questionnaire used in phase 2B has some limitations (see chapter 4), which might limit the effectiveness of the suggested intervention.

Regardless of these limitations, this work has some important strengths: (a) the intervention framework has been developed following a systematic approach based on the BCW guidelines (Michie et al., 2014) and using the outcomes from a pragmatic literature review to guide the decision making. (b) The intervention framework developed in this chapter provides step-by-step guidance for selecting and delivering BCTs according to possible responses from participants on the DARF questionnaire. (c) An example of how delivering the different potential BCTs is also provided.

The intervention framework developed in this chapter can be used to reduce the prevalence of PIA among fitness centres members and to support inactive new members to engage in regular PA behaviour by exercising at fitness centres a specific times per week (it is suggested 2-3 times/week). Moreover, it can be used to increase attendance of some members that might be active but most of their PA are based on walking. However, prior to do so, this framework needs to be transformed into an intervention content according to the settings of the fitness centre where the intervention is going to be applied and pilot testing. Using a randomised control trial in the

testing would increase the reliability of the outcomes and might help to identify possible factors that need to be considered when implementing this intervention framework in a fitness centre setting. On the other hand, the application of this framework should be done by considering that improving members' attendance might result in an increase of people who is exercising at the fitness centre in a given time. This can increase the market but reduce the capability of fitness centres in terms of membership, so future studies should consider this fact in the decision making. It might imply avoiding on-peak hours or encouraging participants to do PA in the lesser overcrowded spaces. Another option might be pilot testing the intervention in centres with a low rate of membership.

5.7. Conclusion

The step-by-step guiding process of the BCW permitted the development a clear framework to target attendance in inactive and low attenders' members of fitness centres or low attenders whose PA is manly based on walking. Furthermore, the selected BCTs facilitates the implementation and testing of this framework in a fitness centre's setting.

Chapter 6

Discussion and conclusions

6.1. Discussion

This doctoral thesis addressed the following research questions: How is the PA participation at fitness centres? What are the determinants and barriers to attend a fitness centre? And what are the characteristics that has to have an intervention targeting fitness centres attendance? To address these research questions three research chapters were conducted (Chapters 3 to 5). Chapter 3 compared the physical activity levels of fitness centres' members with the physical activity levels of the whole population. Chapter 4 explored the effectiveness and validity of a questionnaire named 'Determinants of Attendance Rates in Fitness Centres (DARFC) questionnaire. This questionnaire was designed to help practitioners to identify the needs in terms of the COM-B Model for supporting low-attendance and inactive members to increase their rate of assistance to their fitness centre as a way to increase their current PA levels. Finally, Chapter 5 described the development of a structured intervention model based on the BCW to target attendance a fitness centre.

6.1.1. Fitness centres as promoters of PA

There is a small evidence that fitness centres membership is associated with higher PA levels than the general population and that PA levels increase after enrolment in a fitness centre (Gjestvang et al., 2019b, Hansen et al., 2019, Kaphingst et al., 2007, Schroeder et al., 2017). Thus, enrolment in fitness centres seems to positively contribute to an increase of PA levels. However, these studies did not directly describe nor compare the prevalence of PIA among members of fitness centres to that of the general population. Furthermore, they did not analyse the engagement in PA of members according to factors like gender or age, despite there is a gender and age gap in PA (Bauman et al., 2009, Carlson et al., 2018, Mayo et al., 2019). Accordingly, the findings from Chapter 3 are novel.

The main finding from Chapter 3 show that members of fitness centres have lower prevalence of Low-PA than the general population regardless of gender and age. This supports previous researchers' statement that fitness centres are community centres to target PIA in different adults' populations (e.g., elders or people with cardiovascular diseases) (Annesi, 2003, Beedie et al., 2016, Watts et al., 2017). Furthermore, the fact fitness centre members showed higher High-PA prevalence than in the general population regardless their age and gender, suggests that these places are able to support adults in exceeding the international guidelines for PA what is associated with lower risk of developing non-communicable diseases (Soares-Miranda et al., 2011, Stamatakis et al., 2018, Swain et al., 2020), lower cost for health care systems (Vuori et al., 2013, Wang et al.,

2004)and higher productivity (Bolin, 2018, Pereira et al., 2015). However, further research is needed to confirm these findings due to PA behaviour was self-reported using a questionnaire and two different data sets were used. So, causality cannot be stressed from this chapter.

The existing literature show that women are, in general, less active than men and perform lower vigorous PA (Bauman et al., 2009, Mayo et al., 2019). Women from the fitness centres database represented 52.3% of the sample and they reported a greater High-PA prevalence (40.0% vs 13.0%), lower PIA prevalence (18.6% vs 37.3%) and higher engagement in vigorous-PA than the women from the general population database. Accordingly, it might be assumed that fitness centres are positively contributing to reduce the gender gap in PA and are effective in engaging a high proportion of women in vigorous PA. Nonetheless, even among fitness centres members, the low-PA prevalence is higher in women than men (18.6% vs 12.1%), so the fitness industry should attempt to develop programs and actions to reduce this gap. Furthermore, contrary to women, men mostly fall into the High-PA group showing gender differences in all PA groups. The gender differences among fitness centres members might be due to disparities in objectives to achieve by exercising and the existence of sociospatial gendering processes (Coen et al., 2018, MacIntosh and Law, 2015, Salvatore and Marecek, 2010). Thus, these facts should be considered by the fitness industry when developing programs aiming to reduce the prevalence of PIA among women members.

On the other hand, for all age brackets the members of fitness centres reported less low-PA prevalence, greater High-PA, and greater Vigorous-PA levels than the general population, what suggest that fitness centres are sweet spots for adults to do PA through their life. This is especially important to reduce the impact of chronic health conditions or increase their life expectancy and autonomy of the community (Lee et al., 2012, Moore et al., 2016, Taylor, 2014, World Health Organization, 2020). The older population usually perform less PA and with lower intensity (Bauman et al., 2009, Carlson et al., 2010). However, contrary to the general population dataset, the Moderate-PA prevalence in the fitness centre database increased with the age. Thus, as suggested by Watts et al., (2017) fitness centres seem to play an important role in supporting older people to stay active.

Another novelty of Chapter 3 is the study of the origin of the PA level reported as it might inform of different behaviour the pattern regarding the age, gender, or enrolment in fitness centres. Vigorous-intensity PA represented a higher proportion of total MET-minutes/week in members of fitness centres regardless the PA group (Low-PA [44.5% vs. 14.0%], Moderate-PA [33.3% vs. 12.2%] or High-PA [57.5% vs. 48.8%]), while walking accounted for more than 70% of MET-minutes/week in

the Low-PA and Moderate-PA groups of the general population. The literature suggests that performing vigorous-PA produce additional health benefits (Soares-Miranda et al., 2011, Stamatakis et al., 2018, Swain et al., 2020). Thus, members of fitness centres, may get additional health benefits from their PA behaviour than the general population (Stamatakis et al., 2018).

The findings from this Doctoral Research suggest that fitness centres are able to assist most of their members in being active, so they positively contribute to the PA levels of the community (Annesi, 2003, Beedie et al., 2014). With special importance in women and older adults. Although, to do so, it is important to overcome the low attendance rate reported in these places, and the fact of many members leave the centres within the first 6 months (Sperandei et al., 2016, Sperandei et al., 2019). One way to increase accessibility to fitness centres is through the membership fee as it might help the low-income population to access these places (Faulkner et al., 2019, Higgerson et al., 2018)or to increase the PA levels of a whole community by reducing one of the existing barriers to access a fitness centre (Higgerson et al., 2018). Providing physical activity opportunities according to the gender and age preferences, eliminating socio-spatial gendering barriers and applying behaviour change strategies are other possible solutions to increase the ability of fitness centres to promote PA among the adult's population (Annesi, 2003, Coen et al., 2018, MacIntosh and Law, 2015, Middelkamp et al., 2017, Salvatore and Marecek, 2010).

6.1.2. Determinants for members of fitness centres to increase their attendance rate

The COM-B Model has resulted in an effective instrument to identify the main barriers and facilitators to do PA among different populations (Hankonen et al., 2017, Howlett et al., 2017, Taylor et al., 2016). In addition, a previous study found the COM-B Model to be a useful model for predicting PA; being Psychological Capability and Reflective Motivation the main COM-B constructs to predict PA in healthy adults (Howlett et al., 2017). Thus, it might help to inform the development of an intervention to increase the attendance rate of members of fitness centres as a mean to increase PA.

There are in the literature several surveys attempting to identify the key factors associated with members dropping out of fitness centres (Nuviala Nuviala et al., 2012, Zarotis et al., 2017b). However, preventing drop-out and increasing attendance are two different goals with likely related but distinct determinants (Clavel et al., 2016, Clavel et al., 2020). So, determinants for preventing dropout cannot be applied to improve attendance. Nonetheless, the studies analysing determinants for improving attendance are scare. Therefore, the research conducted in Chapter 4 is novel. The 35-

items questionnaire with excellent content validity shows that there are many different factors behind attendance to a fitness centre and they can be gathered according to the COM-B Model. However, the lack of construct validity suggests that not all these factors have the same impact on this behaviour. The lack of construct validity of the 35-items model can be due to several reason, including the possibility of some items referring to more than one construct (Howlett et al., 2017, Michie et al., 2014), or due to respondents misinterpreted some items. Another reason might be the fact of using a 5-points Likert scale instead of 7-points Likert scale as in other works (Dyson et al., 2013, Taylor et al., 2016). 7-likert scale might help to discriminate among construct as higher standard deviation might be achieved (Dyson et al., 2013, Taylor et al., 2016). Thus, these factors might be considered in future research using this model.

The shorter version with 17-items revealed an acceptable construct validity and the items fall into the six categories of the COM-B Model. So, these items might represent the main determinants for attendance a fitness centre and can be used to inform future intervention using the BCW to increase attendance rate to fitness centres instead of the 35-items model. However, future studies should investigate the test-retest validity of this questionnaire to confirm its reliability (Keyworth et al., 2020, Taylor et al., 2016). On the other hand, the exploratory and confirmatory factorial analysis divided the physical opportunity category into two categories instead of remaining single. This suggests that physical opportunity to attend a fitness centre is subdivided into two dimensions that represent different constructs and different strategies might be needed to target these constructs.

6.1.3. Behaviour Change intervention to increase attendance rate in inactive-low attenders

Promoting attendance in fitness centre might benefit those members who attend less than four times per week as it increases the likelihood of developing a regular attendance habit (Kaushal et al., 2017). Encouraging the members to attend their centre between 2 and 3 times per week might be more realistic approach and is in line to the target set in another research works (Gjestvang et al., 2019a, Gjestvang et al., 2019b, Hansen et al., 2019, Pierce, 2018). Furthermore, it might be sufficient for the members to meet the international guidelines for PA or at least be closer to these recommendations and positively contribute to a decrease of the dropout rate (Clavel et al., 2016, Clavel et al., 2020). However, carful must be taken when targeting attendance as the reported fitness centres' attendance varies between 1.1. to 5.6 times per month (DellaVigna and Malmendier, 2006, Middelkamp et al., 2016). Thus, increasing attendance might reduce the number of members

each centre can enrol and cause overcrowded issues; what would reduce the opportunity for members to do PA at the fitness centres.

In the intervention model defined in Chapter 5, low-active (inactive) members with low attendance rate (less than 2 times per week) are the members who might benefit the most from this intervention as it is more likely they increase their PA levels by increasing their attendance rate. However, low attenders self-reporting moderate PA might be also a target as many members might accumulate most of their weekly meets by walking (López-Fernández et al., 2021). So, increasing the METs coming from non-walking MVPA would provide them additional health benefits (Soares-Miranda et al., 2011, Swain et al., 2020) and potentially result in an increase of their physical fitness (American College of Sports Medicine, 2013).

The nucleus of the BCW is the COM-B Model (Michie et al., 2014), which has been used to design the DARFC questionnaire in Chapter 4. Furthermore, the COM-B Model can be also mapped by the TDF, so it is rationale to use both the BCW and the TDF to inform the different steps of a behaviour change intervention model developed in Chapter 5. Furthermore, the BCW step-by-step guidelines and the TDF have been previously used to designed intervention targeting PIA among different population (Munir et al., 2018, Murtagh et al., 2018, Truelove et al., 2020). Therefore, they might work to inform the development of a behaviour work intervention for attendance despite it is a different behaviour with different determinants.

The outcomes from Chapter 5 evidence that the BCW and TDF are useful to design a structured and evidenced based interventions targeting attendance rate. Although, in this chapter only a general approach was provided as it was not designed to the settings of a specific fitness centre. Future practitioners need to adapt the suggested model to the setting and characteristics of the place the intervention is going to be implemented. To facilitate this step, a recommendation of how the identified BCTs, the way they can be delivered and some examples of how to deliver them in a real context is provided in the designed intervention. On the other hand, the developed intervention suggests the staff of fitness centres to be an active part of the intervention (e.g., delivering BCTs or participating in follow-up processes). For that reason, the intervention model includes an analysis of the main barriers that this staff might have to take part in the intervention.

6.2. Strengths and limitations

First, the originality of the different research works included in this Thesis should be emphasised. For instance, Chapter 3 is the first work that inform about the prevalence of different levels of PA among fitness centres' members and how they differ from the general population considering the gender and age. Moreover, it analyses the origin of the weekly METs, providing a newer understanding about the PA behaviour of fitness centres members as well as the general population. The questionnaire implemented in Chapter 4 is the first questionnaire attempting to identify the main determinants for attending fitness centres to do PA. To design the initial 35-model different approaches including literature searches, focus groups, and experts' revisions were used. Additionally, the 17-item model was implemented based on an exploratory and confirmatory factorial analysis. Chapter 5 provides a detailed evidenced based intervention model that can be used to implement an intervention targeting attendance rate at fitness centre. To develop this intervention literature searches, a four-iteration approach and the step-by-step guidelines of the BCW were used, while all the decision-making processes were detailed.

In contrast, there are several limitations to acknowledge. Regarding Chapter 3, data was collected from different datasets with different methodology and sample size of these databases was not controlled. Thus, causality cannot be stressed from our data. PA habits were self-reported so PA might be overreported. Furthermore, in the case of the fitness centres' dataset, it is possible that highly motivated members were more willing to respond to the survey compared to low-active members, what might underestimate the PIA prevalence among fitness centres members. Combining device-based and self-report PA instruments might provide further information about the habits of this population. Furthermore, using a multi-stage sampling, random design to select members of fitness centres would reduce the bias. While using the same approach to monitor or inquire both members and non-members of fitness centres might permit stress casualty.

In respect to Chapter 4, the sample was not equally distributed with only 21% of participants reporting to be inactive. Furthermore, the predictive validity or intra subject-reliability was not measured as respondents only completed the questionnaire once. On the other hand, to validate the construct of the questionnaire a 5-likert scale. This scale might cause a lower standard deviation from each item than a 7-likert scale and somehow hinder the model to discriminate among the different constructs.

Finally, regarding Chapter 5, the suggested intervention has not been designed for specific setting. Thus, future research needs to adjust the suggested model to the fitness centre's settings where it is going to be applied. Furthermore, the effectiveness of this intervention was not tested, and its effectiveness remains unknown. Also, each fitness centre is different in nature and characteristics, and might not be able to be applied all the identified BCTs.

6.3. Implications for practice and future research

The fact of fitness centres assists most of their members in remain active suggest policy makers and fitness industry to work together to reduce the PIA levels of modern societies, as indicated in previous studies (Beedie et al., 2014, Lopez-Fernandez and Jiménez, 2018). Furthermore, as they also engage women and people from different ages, they can be used to reduce the gender and age gap of PA (Bauman et al., 2009, Carlson et al., 2010, Mayo et al., 2019). Previous studies show a low attendance rate (1.1 to 5.6 times/month) (DellaVigna and Malmendier, 2006, Middelkamp et al., 2016) and high dropout levels (>60% within the first 3 months) (Sperandei et al., 2016, Sperandei et al., 2019). Providing PA opportunities according to the gender and age preferences, eliminating socio-spatial gendering or body composition barriers and implementing behaviour change strategies might increase the likelihood of new members to overcome these limitations (Coen et al., 2018, MacIntosh and Law, 2015, Middelkamp et al., 2017, Salvatore and Marecek, 2010). Furthermore, increase the accessibility to these centres to low-income people and deprived social groups might positively contribute to increase the PA of these groups (Higgerson et al., 2018, Moreno-Llamas et al., 2020).

The most promising way to increase the PA levels of low-active fitness centres' members is by increasing their attendance rate. What might positively contribute to a reduction of the dropout levels (Clavel et al., 2016, Clavel et al., 2020). The 35-items and 17-items can be used by fitness centres to identify possible settings that might increase attendance rate of their members. Furthermore, the 17-items model can be used to inform future research targeting attendance rate. On the other hand, future studies should adapt the proposed intervention to a fitness centre setting and test its effectiveness for improving attendance of inactive-low-attenders' members. Furthermore, the effect of this intervention in dropout levels can be also tested. Finally, increasing attendance might result in an overcrowded issues or higher demands for staff and resources that increased the service costs. Thus, these works should also monitor these factors to provide further understanding of the effect of increasing attendance rate at fitness centres. The use of new technologies to support members of fitness centres to do part or all the planned PA in other spaces

besides the fitness centres (i.e., at home, parks, etc.) or using public spaces nearby to deliver some semi-structured exercise services might reduce the likelihood of overcrowded spaces at fitness centres.

6.4. Conclusion

In relation to the aim of this Doctoral Research, it can be concluded that fitness centres are able to assist most of their members in being active regarding their age or gender. An effective way to improve PA among fitness centres members is the attendance rate. Being inactive-low-attenders' members who might benefit most of increasing the attendance rate. The 17-items questionnaire developed in Chapter 4 has acceptable reliability and validity, so it might be used to develop future interventions targeting members' attendance. Finally, the proposed intervention model can be used to enhance attendance rate in low-attendance-and-inactive members of fitness centres. Further research on the testing of the intervention model defined in Chapter 5 in a fitness centre setting would provide a structure and evidenced-based intervention which can be implemented at scale.

Chapter 7

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Chapter 8

Appendix

Appendix 1. Copy of the manuscript "A comparative analysis of reported physical activity from leisure centres' members vs. the general population in Spain"

Open access Original research

BMJ Open

Comparative analysis of reported physical activity from leisure centres' members versus the general population in Spain

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To cite: López Fernández J, López-Valenciano A, Mayo X, *et al*. Comparative analysis of reported physical activity from leisure centres' members versus the general population in Spain. *BMJ Open* 2021;**11**:e043963. doi:10.1136/bmjopen-2020-043963

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-043963).

Received 21 August 2020
Accepted 04 June 2021

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ABSTRACT

Objectives (1) To describe the physical activity (PA) levels of the members of a Spanish leisure centre operator according to age and gender; (2) to describe the differences in the three PA levels between the members of a Spanish leisure centre operator and the general Spanish population considering the PA Eurobarometer data according to their gender and age and (3) to explore the intensity origin of the PA either in Spanish members of leisure centres or the Spanish population considering their gender.

Design Descriptive epidemiology study.

Participants Data from 16 Spanish leisure centres (n=3627) and from the 2017 Eurobarometer 472 for Spain (n=1002) were used for this research.

Primary and secondary outcomes measures The PA levels were analysed with the International Physical Activity Questionnaire short version, and respondents were grouped into physical inactivity (PIA), moderate-PA and high-PA. Moreover, gender (men or women) and age (18–29 years; 30–44 years; 45–59 years; 60–69 years; ≥70 years) were considered. Total metabolic equivalent (MET)-min/week, as well as total MET-min/week for walking intensity, moderate intensity and vigorous intensity were recorded.

Results Leisure centres showed a lower prevalence of PIA and a higher prevalence of high-PA than the general population (p<0.05). Women displayed a higher prevalence of PIA and lower prevalence of high-PA than men (p<0.05). The prevalence of PIA increases with age while the prevalence of high-PA decreases.

Conclusion Leisure centres engage most of their members in regular PA, including women and older adults, and these members also perform a higher number of MET in vigorous PA, than the general population.

Strengths and limitations of this study

- ► This is the first study that describes the prevalence of different levels of physical activity in members of leisure centres according to their age and gender and analyses how this prevalence differs from the general population.
- ► It also analyses for the first time the intensity origin of the weekly physical activity performed either by the members of leisure centres and the general population according to age and gender.
- ► The database representing leisure centres contains 3627 responses from 16 leisure centres that were spread in seven Spanish regions.
- ► The use of a self-reported instrument to measure the physical activity levels might result in an underestimation of the prevalence of the low-physical activity.

INTRODUCTION

Physical inactivity (PIA) is defined as the default of the weekly Global Recommendations on physical activity (PA).[1] It is different to sedentary behaviour which represents those behaviours performed in sitting or lying position with a low level of energy expenditure (≤1.5 metabolic equivalents (METs)).[2]

The Global Recommendations of PA differ across different age groups (ie, children and adults). Thus, according to the 2020 guidelines, PIA in adults means failing to accumulate 150 min of moderate-to-vigorous aerobic PA throughout the week (<600 MET min).[3] This situation is one of the main risk factors for developing of non-communicable diseases and premature death in adults, so it has become a global public health issue.[4 5] In Spain, like in other European countries, this issue is not an exception, as the lack of sufficient PA or PIA accounted for 9.3% of coronary heart disease, 10.3% of type 2 diabetes, 13.8% of breast cancer, 14.9% of colon cancer and 13.4% of all-cause mortality during 2012. At the same time, life expectancy would increase by 0.78 years if PIA was eliminated.[4] Moreover, healthcare expenditure attributed by PIA in Spain has been quantified in Int$2.024 billion of direct cost, Int$1.425 billion costs for the public sector and Int$461.6 million costs for households.[6]

Thus, reducing the impact of PIA in people's lives, and in public healthcare systems, will bring considerable public health benefits, but remains one of the current challenges for policymakers.[7 8]

The Global Action Plans in 2013 and 2018 challenges the countries to increase their prevalence of PA by at least 10% of 2010 baseline data by 2025 and 15% of 2016 baseline data by 2030.[8 9] However, the levels of PA has diminished in Europe within the last 15 years,[10 11] the same as Spain, where the levels of PA has decreased significantly between 2013 and 2017 in men and women, thereby nullifying the objectives set by the Global Action Plans.[8–10]

The socioecological approach as well as the Global Action Plan suggest that to effectively address PIA, it is required to promote different domains of PA, that is, occupational, travel, home or leisure-time.[8 12] Within these domains, leisure-time PA (LTPA) has resulted effective to reduce the cardiovascular risk in the general population[13] and to improve other health parameters in older adults (ie, body composition, muscle strength or sarcopenia).[14] Moreover, LTPA reduces the risk of premature death regardless of pre-existing health conditions.[15] Since recreational facilities such as leisure centres are one of the main LTPA providers for adults,[16] it might be a good strategy to promote these places to address PIA,[17 18] and combine this approach with further strategies to promote PA in other domains.[12] This view aligns with the authors of the latest Global Action Plan as they encourage policymakers to strengthen and enhance the fitness sector together with other sectors (Action 1.4 and Action 3.3) and combine them with other domains of PA.[8]

Focusing on leisure centres as a key source to promote PA is advisable, as they are specifically designed to engage people in regular LTPA,[17 18] and enjoyed daily by thousands of people, who start, restart or continue with a PA habit.[19 20] In Spain, for instance, around 5.3 million people (≈11.4% of the adult population) are enrolled in a leisure centre. In addition, these centres are designed to address many of the contextual factors that affect people's PA plans (eg, safe environments; social relationship with other users, wide schedule, wide exercise opportunities (individual or collective) and so on), what makes them be a sweet spot for large-scale public PA engagement.[20–22]

Despite these factors, the capability of these centres to promote PA is unknown as it is the percentage of members who can be considered active. Thus, care must be taken when suggesting these centres for promoting PA. The common sense and the anecdotal evidence might suggest that most of the leisure centre members are adequately active when analysing self-reported PA,[23 24] and they are more active than non-members counterparts.[24] Nevertheless, the lack of normative values and comparisons with the general population according to the gender and ages do not allow to conclude these facts.

On the other hand, PIA is age-related, with older adults exercising for significantly less time and at lower intensities than younger individuals.[25 26] It is also gender-related as a higher proportion of women do not engage in sufficient PA and active women accumulate less weekly MET and perform less time of vigorous exercise than men.[10 11 27] Leisure centres seem to reduce this gap because around half of the members of these centres are women.[20 21] Also, they have been proved to be useful in increasing the PA levels and intensity of older adults.[28] However, the prevalence pattern of PA among women and elderly members of leisure centres is still unknown. Thus, the objectives of this study were (1) to describe the PA levels of the members of a Spanish leisure centre operator according to gender and age; (2) to describe the differences in the three PA levels between the members of a Spanish leisure centre operator and the general Spanish population considering the PA Eurobarometer data according to their gender and age; (3) to explore the intensity origin of the PA either in Spanish members of leisure centres or the Spanish population considering their gender.

It is expected that this work provides normative values about the prevalence of PA in leisure centres according to the age and gender what might help to understand the effectiveness of these places for promoting PA. Moreover, since the WHO is encouraging the policymakers to strengthen the leisure centres in order to improve PA levels of modern societies,[8] the findings from this work might help to set the role of leisure centres to address PIA in different populations.

MATERIALS AND METHODS

Study design and data sources

This is a descriptive epidemiology study. The data used in this study come from two different databases. The first one is the 2018 GO fit Observatory raw data, which was provided by a Spanish leisure centres operator (GO fit-Ingesport Health & Spa Consulting SA) that periodically survey its customers about their current PA and service satisfaction. This survey was conducted via online between January and June of 2018. The sample inquired comes from 16 fitness and leisure centres (n=3627), which are spread in 7 of the 17 Spanish Regions (Andalucía, Cantabria, Castilla y León, Castilla-La Mancha, Comunidad de Madrid, Gran Canarias and Principado de Asturias). The survey used a stratified random design based on the number of members per centre, their gender and their age. All leisure centres were operated by a private organisation and were equipped by an indoor swimming pool, several spaces for collective classes and a fitness room. All centres offered different sort of exercise services including individualised exercise programmes and collective classes (eg, endurance, dancing, jumping, well-being and so on) and nutritional services. The second database comes from the 2017 Special Eurobarometer 472,[29] a public opinion surveys that the European Commission simultaneously conducts on all the European Union state members to understand the levels of PA and sports participation of each country's population. In this case, data were obtained from the adult Spain population (n=1002) a few months before GO fit-Ingesport conducted their

2018 Observatory survey. The Eurobarometer surveys are conducted under a multistage sampling, random design. In order to cover the whole territory of the country, the number of sampling points is drawn with probability proportional to both population size and population density. To this purpose, the age, gender, region and the size of the locality are introduced in the iteration procedures.[29]

Measurements

Both data sources used the short form of the International Physical Activity Questionnaire (IPAQ), which is used to inquire about the levels of PA.[30] This instrument measures the intensity, frequency and duration of PA performed within the previous 7 days by examining the number of days performing vigorous, moderate and walking PA and the total minutes during those days.[30] The 2018 GO fit Observatory used an online version of the short form of the IPAQ with the classical open solution as responses were not truncated. On the contrary, the Special Eurobarometer 472 survey used a modified version of the IPAQ with responses truncated to five different fixed possibilities, instead of the classical open solution, to indicate the minutes performed in each activity.[29 30] In order to reduce the bias due to the approach differences between databases both sources, the responses from the GO fit Observatory were truncated according to the methodology used in the Special Eurobarometer 472. Thus, for the case of PA, in both cases a response of '30 min or less' was assumed to mean 15 min, a response of '31 to 60 min' was assumed to mean 45 min, a response of '61 to 90 min' was assumed to mean 75 min, a response of '91 to 120 min' was assumed to mean 105 min and a response of 'more than 120 min' was assumed to mean 120 min.[31]

The data processing and analysis were completed using a modified ad hoc spreadsheet available online[32] according to the instruction for data processing and analysis of the IPAQ short form[30] and the methodology used in recent studies.[10 11] Only individuals with at least one valid intensity and duration of a particular intensity (ie, both variables with a different answer than 'don't know') were analysed. In this regard, 'Moderate-PA' was considered when reporting (a) at least 3 days of vigorous intensity activity of at least 20 min per day; (b) at least 5 days of moderate intensity activities and/or walking for at least 30 min per day or (c) at least 5 days combining the intensities mentioned above achieving at least 600 MET-min/week. 'High-PA' was considered when reporting (d) three or more days of vigorous-intensity activity of at least 20 min per day; or (e) five or more days of moderate-intensity activity and/or walking of at least 30 min per day MET-min/week. 'Low-PA' (inactive or PIA) was considered if not meeting any of these thresholds.[30] Moreover, moderate-PA and high-PA were considered as active. The METs of the respondents were calculated accordingly to the existing guidelines so that walking-intensity, moderate-intensity and vigorous-intensity accounted for 3.3, 4.0 and 8.0 METs, respectively.[30] Thus, walking, moderate and vigorous MET-min/week were calculated by multiplying the selected MET value by the minutes and days of each intensity. The total PA MET-min/week was obtained by summing up the walking, moderate and vigorous MET-min/week score. On the other hand, in order to explore the origin of the MET-min/week for the three groups of PA analysed (low-PA, moderate-PA and high-PA), the average MET-min/week for walking, moderate and vigorous PA and total average MET-min/week in each group were calculated. Using these values, the proportion (%) of MET-min/week coming from walking, moderate and vigorous activities was also estimated.

Statistical analysis

For the analysis of PA prevalence levels (low-PA, moderate-PA and high-PA), data were displayed as a proportion (%) with 95% CI. In this regard, analysis between the leisure centres and the Eurobarometer was analysed with a χ^2 test for the overall sample and separately by gender and age groups (18–29 years, 30–44 years, 45–59 years, 60–69 years and ≥70 years). Z-score for two population proportions was used for this purpose. A χ^2 test for the overall sample and separately by the gender and age was also used to compare the origin of the MET-min/week for the three PA groups (low-PA, moderate-PA and high-PA) between members from the leisure centres and people from the Eurobarometer. Once again, Z-score for two population proportions was used for this purpose. These tests were conducted using Microsoft 365 Excel V.2003 (Build 12624.20320; Microsoft Corporation; Redmond, Washington, USA). On the other hand, the differences in total MET-min/week between leisure centres and Eurobarometer, also considering gender, were analysed by a two-way Analysis of Variance (ANOVA). To this purpose, linearity, skewness and asymmetry were considered. These analyses were conducted using the Statistical Package for Social Sciences (V.22.0, SPSS). The level of significance was established at 0.05.

Patient and public involvement

The authors confirm that patient and public was not involved in the research.

RESULTS

Demographic data from the participants in both leisure centres' survey and Eurobarometer survey are displayed in table 1. In both databases, slightly more women were recruited than men. Moreover, members of leisure centres were younger than those representing the Spanish population (−8.68 years).

As can be identified in table 2, significant differences were found in the three levels of PA between leisure centres and the general Spanish population. In this regard, the percentage of low-PA population was significantly higher in the general Spanish population either for the whole sample or for women and men separately ($p<0.001$). The prevalence of moderate-PA was also

Table 1 Participants' demographic characteristics

Database	# Women	% Women	# Men	% Men	Age*
GO fit-Ingesport operated leisure centre (GO fit Observatory)	1898	52.3	1729	47.7	42.67±12.05
Spanish general population (Special Eurobarometer 472)	555	55.4	447	44.6	51.35±18.20

*Age: expressed as mean±SD

higher in the general Spanish population either for the whole sample, and women and men separately (p<0.001). On the contrary, the GO fit-Ingesport operated leisure centres showed a higher prevalence of high-PA for the whole sample and for women and men separately. Considering gender, women showed a higher low-PA and a lower high-PA prevalence in comparison with men in both samples (p <0.001–0.015, respectively). Considering the age of the samples, similar findings were reported as to the total population in which the low-PA population were descriptively increasing with the age brackets and high-PA levels being reduced with every new age bracket.

Table 3 shows the origin of the MET-min/week for the three PA groups (low-PA, moderate-PA and high-PA). The low-PA population and population with moderate-PA levels from GO fit-Ingesport operated leisure centres showed a higher proportion of METs coming from vigorous-intensity and a lower proportion of METs coming from walking than the Spanish population, despite having similar %METs of moderate intensity. This was confirmed for the whole sample and considering the gender subssamples, except for women in the moderate-PA levels, in which GO fit-Ingesport members also had higher levels of moderate intensity METs than the Spanish population. In high-PA population, there were no differences in the %METs walking between sample. However, GO fit-Ingesport members reported higher %METs of vigorous activity and lower %MET of moderate activity in comparison with the general Spanish population.

Considering gender, there were differences between women and men for all levels and intensities except for the %METs at moderate-intensity in the GO fit-Ingesport sample and for the low-PA group of the Spanish population regarding %MET at moderate-intensity (p>0.05). In this regard, in both samples and in the three levels of intensity, women had a higher percentage of METs coming from walking and a lower percentage of METs coming from vigorous intensity (p<0.005).

Finally, the total MET-min/week achieved by both samples are displayed in figure 1. Despite no interaction effect between gender and sample was found, the total MET-min/week of GO fit-Ingesport centre members were significantly higher than the general Spanish population (3051.59 METs vs 1784.52 METs; p<0.001). The same was reported for both women (2732.16 METs vs 1461.07 METs; p<0.001) and men (3402.26 METs vs 2186.12 METs; p<0.001). On the other hand, women showed a lower total MET min/week in both the sample from leisure centres and the Spanish population (p<0.001).

DISCUSSION

The main findings of this study are that: (a) around 80% of the members of a Spanish leisure centre operator self-report to be active; (b) the prevalence of low-PA and moderate-PA in leisure centre members is lower than in the Spanish population, yet the leisure centre members show higher levels of high-PA regardless the age and gender; (c) the prevalence of low-PA is higher in women in both leisure centres and the general population compared with men; (d) members of leisure centres show less low-PA for all age brackets than the general population and (e) the intensity of PA differs according to the total level of individual PA.

The high prevalence of PA in Spanish leisure centres (84.5%) is in line with the prevalence reported in leisure centres from the USA (~88%).[23 24] Gjestvang *et al*,[33] using accelerometers found that new members of leisure centres accounted for a lower prevalence of PIA after 12 months than the prevalence of PIA reported by the Norway population in other studies.[34 35] However, no one has specifically and directly described the difference in prevalence of PIA among members of leisure centres to that of the general population, particularly with respect to gender and age. Therefore, our finding that leisure centres' members to have a lower prevalence of PIA than the general population regardless of gender and age group is novel.

Regarding gender, women showed higher PIA prevalence than men, in agreement with previous studies.[10 27 36] Women also perform less vigorous-PA, which may prevent women from gaining the full benefits of PA.[37] The positive finding is that women from leisure centres reported much higher high-PA (40.0% vs 13.0%), lower levels of PIA (18.6% vs 37.3%) and higher engagement in vigorous-PA than the general population. Therefore, leisure centres seem to be useful to engage women in regular PA and vigorous PA beyond what is typically seen in the general population. Moreover, women represented 52.3% of the sample from leisure centres, showing that leisure centres might be useful places to support women in decreasing PIA and increasing PA.[20] The gender differences in leisure centres, that is, women more engaged in moderate-PA and men in high-PA, may be due to the way

Table 2 Prevalence (expressed as percentage) of low-PA, moderate-PA and high PA adults between the GO fit-Ingesport operated leisure centre members and the general Spanish population

	GO fit-Ingesport operated leisure centre (GO fit Observatory)							Spanish general population (Special Eurobarometer 472)							GO fit-Ingesport operated leisure centre – Spanish general population					
		Low-PA (PIA)		Moderate-PA		High-PA			Low-PA (PIA)		Moderate-PA		High-PA		Low-PA (PIA)		Moderate-PA		High-PA	
	n	%	95% CI	%	95% CI	%	95% CI	n	%	95% CI	%	95% CI	%	95% CI	Z-score	P value	Z-score	P value	Z-score	P value
All sample	3627	15.5	14.3 to 16.8	37.4	36.0 to 39.0	47.0	45.4 to 48.7	1002	34.0	31.1 to 36.9	48.3	45.2 to 51.2	17.7	15.3 to 20.1	13.08	<0.001*	6.22	<0.001*	16.75	<0.001 †
Women	1898	18.6	16.9 to 20.3	41.3	39.2 to 43.6	40.0	37.8 to 42.3	555	37.3	33.2 to 41.3	49.7	45.7 to 54.1	13.0	10.1 to 16.0	9.23	<0.001*	3.50	<0.001*	11.85	<0.001 †
Men	1729	12.1	10.6 to 13.7	33.1	30.9 to 35.4	54.7	52.5 to 57.2	447	30.0	25.8 to 34.1	46.5	42.0 to 51.3	23.5	19.6 to 27.6	9.21	<0.001*	5.26	<0.001*	11.78	<0.001 †
Z-score		5.36		5.11		8.84			2.43		1.01		4.34							
P value		<0.001‡		<0.001		<0.001‡			0.015‡		0.314		<0.001‡							
Age																				
18–29 years	535	9.5	7.1 to 12.1	30.7	26.6 to 34.6	59.8	55.9 to 64.2	147	19.7	13.2 to 26.1	55.8	48.0 to 64.0	24.5	17.4 to 31.3	3.40	0.001*	5.62	<0.001*	7.59	<0.001 †
30–44 years	1562	15.2	13.6 to 17.0	37.8	35.5 to 40.1	46.9	44.6 to 49.5	234	33.3	27.0 to 39.6	49.1	42.7 to 56.1	17.5	12.8 to 22.4	6.78	<0.001 *	3.30	0.001*	8.47	<0.001†
45–59 years	1168	17.0	14.9 to 19.3	38.6	35.9 to 41.4	44.4	41.7 to 47.0	264	33.3	27.8 to 38.9	47.7	42.0 to 53.8	18.9	14.3 to 23.9	6.00	<0.001 *	2.72	0.006*	7.63	<0.001 †
60–69 years	279	20.1	15.8 to 25.3	40.1	34.2 to 46.0	39.8	33.8 to 45.7	159	34.6	27.1 to 41.8	45.9	36.1 to 54.1	19.5	13.6 to 26.1	3.36	0.001*	1.28	0.240	8.49	<0.001 †
≥70 years	63	25.4	14.5 to 36.0	50.8	37.9 to 62.5	23.8	14.0 to 34.8	198	46.0	38.7 to 52.8	44.4	37.9 to 51.3	9.6	5.7 to 13.9	2.89	<0.004*	0.88	0.378	2.92	0.004†

Significantly higher prevalence (p<0.05) in men compared with the women.
*Significantly higher prevalence (p<0.05) in Eurobarometer compared with the leisure centres.
†Significantly higher prevalence (p<0.05) in the leisure centres compared with the Eurobarometer.
‡Significantly higher prevalence (p<0.05) in women compared with the men.
High-PA, high active according to the guidelines of the IPAQ short version questionnaire; ; Low-PA (PIA), low active according to the guidelines of the IPAQ short version questionnaire. This group is considered as physical inactive (PIA); Moderate-PA, moderate active according to the guidelines of the IPAQ short version questionnaire; PA, physical activity.

Table 3 Origin of the MET-min/week in the three PA intensity (low-PA, moderate-PA and high-PA) either for leisure centres or Eurobarometer

		GO fit- Ingesport operated leisure centre (GO fit Observatory)			Spanish general population (Special Eurobarometer 472)			GO fit-Ingesport operated leisure centre—Spanish general population					
								%METs walking intensity		%METs moderate intensity		%METs vigorous intensity	
		%METs walking intensity	%METs moderate intensity	%METs vigorous intensity	%METs walking intensity	%METs moderate intensity	%METs vigorous intensity	Z-score	P value	Z-score	P value	Z-score	P value
Low-PA	All sample	43.7	11.9	44.5	73.2	12.8	14.0	7.88	<0.001*	0.36	0.717	8.61	<0.001†
	Women	52.5	10.4	37.2	81.6	12.7	5.8	7.43	<0.001*	0.92	0.355	8.74	<0.001†
	Men	32.1	13.9	54.0	64.7	12.8	22.5	9.81	<0.001*	0.45	0.652	9.49	<0.001†
	Z-score	7.02	1.81	5.72	4.31	0.05	5.29						
	P value	<0.001‡	0.070	<0.001	<0.001‡	0.960	<0.001						
Moderate-PA	All sample	52.0	14.7	33.3	74.0	13.8	12.2	13.02	<0.001*	0.75	0.452	14.29	<0.001 †
	Men	47.0	15.0	38.0	67.2	16.5	16.3	11.84	<0.001*	1.27	0.205	14.11	<0.001 †
	Women	55.8	14.6	29.6	79.3	11.7	9.0	14.20	<0.001*	2.41	0.016†	12.49	<0.001 †
	Z-score	5.26	0.33	5.31	7.60	3.87	6.07						
	P value	<0.001‡	0.739	<0.001	<0.001‡	<0.001	<0.001						
High-PA	All sample	25.3	17.2	57.5	25.2	26.0	48.8	0.21	0.837	13.32	<0.001*	29.82	<0.001†
	Men	23.3	16.6	60.1	24.2	25.0	50.8	1.15	0.255	10.56	<0.001*	9.64	<0.001†
	Women	28.0	17.9	54.1	26.8	27.8	45.5	1.32	0.188	11.43	<0.001*	8.43	<0.001†
	Z-score	5.29	1.72	5.98	2.98	3.23	5.44						
	P value	<0.001‡	0.085	<0.001	0.003‡	0.001‡	<0.001						

Significantly higher prevalence (p<0.05) in men compared with the women.
*Significantly higher prevalence (p<0.05) in Eurobarometer compared with the leisure centres.
†Significantly higher prevalence (p<0.05) in the leisure centres compared with the Eurobarometer.
‡Significantly higher prevalence (p<0.05) in women compared with the men.
High PA, high active according to the guidelines of the IPAQ short version questionnaire; Low-PA, low active according to the guidelines of the IPAQ short version questionnaire, This group is considered as physical inactive (PIA); Moderate PA, moderate active according to the guidelines of the IPAQ short version questionnaire; PA, physical activity.

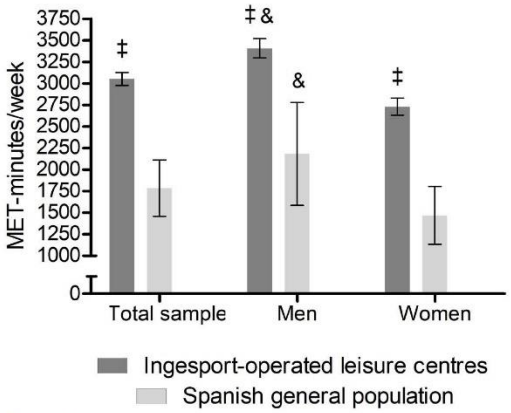

Figure 1 Average total MET-min/week between the leisure centre and the Eurobarometer for all participants and for men and women separately. ‡ Significantly higher MET-min/week (p<0.05) in the leisure centres regarding the Eurobarometer. & Significantly higher MET-min/week (p<0.05) in men regarding the women. MET: metabolic equivalent.

both genders use these centres, their objectives to achieve by working out in fitness centres, and the existence of sociospatial gendering processes.[38–40]

This manuscript shows that the prevalence of PIA increases with the age both in leisure centres and in the general population, coinciding with previous studies that reported a higher prevalence of PIA in older adults.[25 26] However, the lower prevalence of PIA in all age brackets for leisure centre members enhances the importance of these centres as places of exercise providers.[20 21 24] The prevalence of high-PA decreases with age in both samples, yet high-PA was more than two times as high in leisure centre members regardless of age. Therefore, although levels of regular PA are aged-related, members of leisure centres seem to perform more vigorous-PA than the general population[24] may be due to the characteristics of the exercise that can be performed in these centres.[20 23 41] Among the different age groups studied, older adults (≥60 years old) are a significant target group for PA interventions due to the lower overall engagement in PA,[25 26] and also because many older adults have chronic health conditions or disease as a consequence of PIA, or that can be improved by prescribed exercise.[42 43] This study shows that up to 39.8% of adults between 60 and 69 years old and up to 23.8% of adults >69 years were classified in the high-PA group. Furthermore, contrary to the trend of the general population, the prevalence of moderate-PA in leisure centre members improves as age increases. Thus, as suggested by Watts *et al*,[28] leisure centres seem to play an important role in supporting older people to stay active. Therefore, leisure centres can likely be considered effective environments for promoting and developing active living and healthy ageing interventions.

The origin of the PA level reported is also a new finding, although a previous study suggested that members from leisure centres exercise more intense than non-members.[24] Gerovasili, *et al*,[31] explored the origin of total MET-min/week among the European Union Countries, however, they did not make subgroups according to their PA levels nor consider the gender and age of participants. The literature suggests that meeting PA guidelines reduces the likelihood of developing cardiovascular, metabolic and other non-communicable diseases,[6 44–46] however, performing vigorous-PA seems to produce additional health benefits.[37 47–49] Therefore, even when meeting the PA guidelines there are increased benefits to including additional minutes of vigorous-PA.[37 47–49] Vigorous-intensity PA represented a higher proportion of total MET-min/week in members of leisure centres regardless the PA group (low-PA (44.5% vs 14.0%), moderate-PA (33.3% vs 12.2%) or high-PA (57.5% vs 48.8%)), while walking accounted for more than 70% of MET-min/week in the low-PA and moderate-PA groups of the general population. Thus, members of leisure centres, given the greater proportion of higher intensity PA, may derive additional health benefits compared with the general population.[48]

Previous studies have explored the average MET-min/week in adults,[31 50] however, this has not been done in leisure centre users. GO fit-Ingesport leisure centre members showed an average MET-min/week (3051.59) much higher than the general population of Spain, and comparable to the two most active European countries in 2013 (Latvia=3027; Estonia=2910).[31] On the other hand, the total MET-min/week average in 2013 for Spain[31] are higher than those found in this study (2166 vs 1784.52), suggesting that the PA levels of Spanish households may have decreased in the last years.[10] Regarding gender, the outcomes from total MET-min/week also corroborate that men reporting being more active than women.[10 27 36] However, once again, leisure centre members of both genders show significantly higher PA levels than the general population.

The ability of leisure centres to engage people from all ages, but specially women and older adults, enforces the suggestion that European countries should develop specific strategies to engage leisure centres in the overall mitigation of population-based PIA.[17 18] These centres can also be used for targeting diseases related to PIA.[28 51] We acknowledge that many leisure centre members do not regularly exercise within the centres, and that many members leave the centres within the first 6 months.[52 53] Moreover, a significant proportion of new members report being inactive before enrolling[53] while the cost of the membership fee might be a barrier for some people.[54] Thus, we encourage policymakers and the fitness industry to work together in order to increase the accessibility to these centres to low-income people and to develop effective formulas to reduce the gender and age gaps that exist in PA habits.[10 25 26] Providing PA opportunities according to the gender and age preferences,

eliminating sociospatial gendering barriers and applying behaviour change strategies in these centres might work to improve the effectiveness of leisure centres as PA providers and improve access to these places to disadvantaged groups.[18 38–40 55]

Despite the large sample size used in this study, it is important to consider the following limitations. (a) It is possible that highly motivated members were more willing to respond to the survey compared with those who engaged in mostly low-PA, and that this could bias the results; (b) data from this work were based on self-report questionnaires which may over-report PA levels,[56] so caution should be despite large samples (c) the Eurobarometer truncate the solutions from the IPAQ questionnaire[10] while the sample from the leisure centres used the classical open solutions,[30] so the total minutes in each category of PA were artificially assumed according to the suggestion of Gerovasili *et al*.,[31] (d) It was not possible to manage the sample size of both databases used in this study. Thus, causality cannot be stressed from our data. A particular strength, however, is that all of the centres analysed were spread among 7 of the 17 Regions of Spain, thereby increasing external validity. Based on the main limitation of this study, future studies should combine device-based and self-report PA instruments to investigate differences in PA prevalence in these two populations. This would allow comparison of effects sizes between different instruments capable of assessing distinct PA constructs and identify any potential discrepancies according to age and gender.

CONCLUSIONS

Members of leisure centres are mostly active as only 15.5% of members of the members of the Spanish GO fit-Ingesport leisure centres reported to be low-PA, while 47.0% reported to be high-PA. Moreover, the members of leisure centres showed lower prevalence of PIA and a higher prevalence of high-PA than the Spanish population regardless gender and age. As a consequence, GO fit members showed higher MET-min/week than the general population. Differences in PA levels between men and women were confirmed either in leisure centres members or the general population. However, both men and women of GO fit-Ingesport leisure centres showed higher MET-min/week than the general population. Vigorous PA represented a higher proportion of total MET-min/week in leisure centres' members than in the general population regardless of the PA group (low-PA; moderate-PA; high-PA). Moreover, more than 70% of METs in the low-PA and moderate-PA of the Spanish population were due to walking.

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Contributors JLF, XM and AJ conceptualised the research; JLF, AL-V, XM and AJ set the methodology followed in this research; JLF and AL-V completed the data curation and formal analysis; JLF, AL-V, XM and AJ reviewed and validated the data analysis; JLF and AL-V drafted the manuscript; JLF, AL-V, XM, EH, IC, GL and AJ critical reviewed the manuscript and completed the required changes; EH, IC, GL and AJ coordinated the different stages of the research. All authors have read and agreed to the published version of the manuscript and agree the order of presentation of the authors.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests JLF acknowledges that his PhD studies have been funded by GO fit-Ingesport. AL-V also acknowledges he is a postdoctoral research fellow funded by GO fit-Ingesport at the Centre for Sports Studies of King Juan Carlos University. AJ acknowledges he serves at a fractional role as Chief Research & Innovation Officer at GO fit-Ingesport.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval Ethical approval for this study was not required. Eurobarometer 472 database has been published by the European Commission and, it is public access. Go fit database was provided by a Spanish leisure centres operator (GO fit-Ingesport Health & Spa Consulting SA) that periodically survey its customers about their current PA levels and service satisfaction. Customers were informed that the conducted survey could be used to conduct market studies and also research studies. No personal data or data that could be used to identify a person was included in GO fit database.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data are available upon reasonable request. The raw data of the Eurobarometer 472 is owned by the European Commission and available online: https://dbk.gesis.org/dbksearch/sdesc2.asp?no=6939&search=Physicalfitnessandexercise&search2=&field=all&field2=&DB=e&tab=0&notabs=&nf=1&af=&ll=10. The raw data from the Spanish fitness centre operator is owned by GO fit-Ingesport Health & Spa Consulting SA. To request access to this data contact to the corresponding author.

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Appendix 2. Methodology of the pragmatic review conducted in Chapter 4

Three criteria were used in the development of the pragmatic review. For the first criterion (Physical activity/exercise/attendance interventions located or delivered from a fitness centre or similar / Research focused on fitness centres or similar that somehow explore possible barriers or factors that can affect the attendance rate), the searching process was divided into two steps. First, combining the terms included in the concepts "*Places*" and "*Activity Type*"; and second, combining the terms from the concepts "*Places*" and "*Search term*" (*APP2-Table 1*)

App2-*Table 1*. Keywords and search strategy used for the criterion "*physical activity/exercise interventions located or delivered from a community fitness centre*"

Concept	Search items
Filters	From 2008 to 2018; English spelling; Adults (over 19 years old)
Places	*British English:* Gym; Fitness centre; Leisure centre; Health club; Sports club *American English:* Fitness center; Leisure center; community center
Activity type	Physical inactivity; Physical activity; Exercise
Search terms	*British English:* Adherence; Attendance; Dropout; Exercise Program; Intervention; Quality; Satisfaction;

For the second criterion (*revisions addressing physical inactivity [physical activity / exercise] or identifying effective methods to enhance physical activity/exercise in adults*), the searching process was completed by combining the terms included in the concepts "*Research type*", "Population", "*Activity Type*" and "intervention terms (*APP2-Table 2*).

App2-*Table 2*. Keywords and search strategy used for the criterion "*revisions addressing physical inactivity (physical activity / exercise) or identifying effective methods to enhance physical activity/exercise in adults*"

Concept	Search items
Filters	From 2008 to 2018; English spelling; Adults (over 19 years old)
Research type	Review; Systematic review; Meta-analysis; Scientific integrity review;
Population	Non-clinical adults; Healthy adults
Activity type	Physical inactivity; Physical activity; Exercise
Intervention term	*British English:* Adoption, Adherence; Behaviour; Behaviour change; Behaviour change intervention; Behaviour change modification; Behaviour change strategy; Behaviour Change Technique; BCT; Behaviour Change Wheel; BCW; Behaviour intervention; Behaviour modification; COM-B model; Exercise behaviour; Exercise intervention; Health behaviour; Intervention; Intervention behaviour; Lifestyle change; Lifestyle intervention; Lifestyle modification; MVPA; Physical activity behaviour; Physical activity intervention; Physical inactivity behaviour; Physical inactivity intervention; Sedentary behaviour; Sedentary intervention *American English:* Behavior; Behavior change; Behaviour change intervention; Behavior Change Technique; Behavior change strategy; Behavior intervention; Behavior modification; Exercise behavior; Health behavior; Intervention behavior; Physical activity behavior; Physical inactivity behavior; Sedentary behavior

Similar searching process was used for the third criterion (*research interventions targeting physical inactivity or exercise in non-clinical adults, healthy adults, and adults without metabolic or*

cardiovascular disease). T*he* searching process was completed by combining the terms included in the concepts "*Research type*", "Population", "*Activity Type*" and "intervention terms (*APP2-Table 3*).

App2-*Table 3*. Keywords and search strategy used for the third criterion "*research interventions targeting physical inactivity or exercise in non-clinical adults, healthy adults, or adults with metabolic or cardiovascular disease / interventions using the behaviour change wheel in any adult population for promoting physical activity*"

Concept	Search items
Filters	From 2008 to 2018; English spelling; Adults (over 19 years old)
Population	Non-clinical adults; Healthy adults
Intervention filters	Case reports; Clinical study; Clinical trial; Consensus development conference; Technical report; Controlled clinical trial; Government publications; Guideline; Pragmatic clinical trial; Randomized controlled trial (RCT); Randomised trial; Controlled trial; Intervention trial; Longitudinal study
Activity type	Physical inactivity; Physical activity; Exercise
Intervention term	*British English:* Adoption, Adherence; Behaviour; Behaviour change; Behaviour change intervention; Behaviour change modification; Behaviour change strategy; Behaviour Change Technique; BCT; Behaviour Change Wheel; BCW; Behaviour intervention; Behaviour modification; COM-B model; Exercise behaviour; Exercise intervention; Health behaviour; Intervention; Intervention behaviour; Lifestyle change; Lifestyle intervention; Lifestyle modification; MVPA; Physical activity behaviour; Physical activity habits; Physical activity intervention; Physical inactivity behaviour; Physical inactivity habits; Physical inactivity intervention; Sedentary behaviour; Sedentary intervention *American English:* Behavior; Behavior change; Behaviour change intervention; Behavior Change Technique; Behavior change strategy; Behavior intervention; Behavior modification; Exercise behavior; Health behavior; Intervention behavior; Physical activity behavior; Physical inactivity behavior; Sedentary behavior

Due to the searching scope was very wide, a total of 38,687 papers were selected in the first screening process. From these papers, a total of 4,346 were identified as potential papers only using the title (Revision Round 1). Afterwards, a second screening process was performed in order to select the final list of potential papers (Revision Round 2). In this second screening process, the title and abstract were reviewed. However, a full reading was done if further information was required to select or reject the paper. Moreover, the reference list of the manuscript was also screened to identify additional potential papers. In total 414 papers were selected in the Revision Round 2. For the Revision Round 3, all the potential papers were listed in a random order. This list was followed to conduct the pragmatic literature review until saturation. In this study, saturation was considered when the information from ten papers screened in a row did not provide relevant information to design a new potential item for the questionnaire. However, to reduce the risk of bias, a minimum of reviewing 50% of the potential papers screened papers was set. In total, 357 papers were screened (86%), but only 65 were used to design the first version of the questionnaire (*APP2*-Table 4; *APP2*-Table 5; and *APP2*-Table 6).

App2-Table 4. Manuscript review for the first search criterion (*Physical activity/exercise/attendance interventions located or delivered from a fitness centre or similar in healthy adults and/or clinical adults / Research focused on fitness centres or similar that somehow explore possible barriers or factors that can affect the attendance rate or to these centres or the exercise levels of the members of these centres*)

Authors	Study design	Sample characteristics	Groups characteristics	Main objective
Amin et al. [1]	RCT	19 older clinical adults (> 60 years)	Randomised groups	To investigate whether a novel, community-based exercise program (CBE) was feasible and effective for patients with moderate Chronic obstructive pulmonary disease (COPD).
Arikawa et al. [2]	RCT	164 premenopausal inactive women	Randomised groups	To provide an analysis of demographic factors contributing to women's adherence to a 2-year twice-weekly weight training intervention
Blais et al. [3]	Quasi-experimental	88 non-clinical adults	Non-randomised groups	To examine the effectiveness of a 12-week weight loss intervention within a commercial fitness centre on body weight, moderate to vigorous physical activity (MVPA), dietary intake, and behavioural regulations for exercise and healthy eating.
Brown et al. [4]	Qualitative	657 non-clinical adults	Not applicable	To compare current, former, and non-members' perceptions of the motivational climate of a university campus fitness facility
Caudwell and Keatley [5]	Cross sectional	100 non-clinical males' adults	Not applicable	To investigate the influence of men's body attitudes alongside implicit and explicit motivation on gym attendance.
Coen [6]	Qualitative	52 non-clinical adults	Not applicable	To advance a more critical geography of physical activity that contends with the micro-level socio spatial processes implicated in gendering physical activity participation and thus, health.
Crespin et al. [7]	Quasi experimental	2972 non-clinical adults	Non-randomised	To examine the effect of participation in an incentive-based wellness program on self-reported exercise.
Fisher et al. [8]	Qualitative research	8 non-clinical women (20-30 years + one of 64 years)	Not applicable	To illuminate women's gendered experience within a traditional, mixed gendered gym
Foley et al. [9]	RCT	106 clinical older adults (> 60 years)	Randomised groups	To determine whether high-intensity, progressive gym-based exercise performed once a week is as effective as twice weekly for maintaining both subjective and objective outcomes in older adult s' post discharge from a metropolitan day rehabilitation centre (DRC).
Gazmararian et al. [10]	RCT	410 non-clinical adults	Randomised groups	To evaluate the effectiveness of addressing multiple barriers to physical activity (PA) using interventions at the workplace
García-Fernández, et al. [11]	Quasi-experimental	1805 non-clinical adults	Non-randomised groups	To analyse the relationship between quality, value, satisfaction and the future intentions of clients of public and private low-cost fitness centres and their difference
Gonçalves et al. [12]	Cross sectional	146 non-clinical adults	Not applicable	To understand how attributes perception, expectations, well-being and satisfaction influence membership retention in fitness clubs
Jasinskas et al. [13]	Quasi-experimental	433 non-clinical adults	Not applicable	To evaluate the quality of services in fitness centres in Kaunas
Jekauc et al. [14]	Cross sectional	101 non-clinical adults	Not applicable	To evaluate the predictability of the future behaviour by the Physical Activity Maintenance Theory and compare it with the Theory of Planned Behaviour (TPB) and Social Cognitive Theory (SCT).
Kaushal and Rhodes [15]	Cross sectional	111 non-clinical adults	Not applicable	To investigate the behavioural requirements for exercise habit formation
Kaushal et al. [16]	RCT	94 non-clinical adults)	Randomised groups	To test if changes in habit, as well as other behavioural strategy constructs from the Multi-Process Action Control Test, mediated between group condition and MVPA (self-report and accelerometery)
Kaushal et al. [17]	RCT	94 non-clinical adults	Randomised groups	To examine the impact of a habit formation intervention on PA over 8 weeks in a two-arm parallel design, randomized controlled trial

MacIntosh and Law [18]	Qualitative research	26 non-clinical adults	Not applicable	To identify and compare the reasons why people join, maintain, and cancel their fitness membership through the lens of the TPB, while incorporating concepts from service quality and organisational culture research.
Mazzuca et al. [19]	Quasi-experimental	101 clinical adults	Randomised intervention groups (no control group)	To define the relative effectiveness of the supervised physical activity program vs. a cognitive-behavioural intervention promoting self-selected physical activity in subjects with obesity or type 2 diabetes
Middelkamp, et al. [20]	Experimental research	122 non-clinical adults	Randomised groups	To test the effects on exercise behaviour over 52 weeks and the long-term relationships of all TTM constructs
Miller and Miller [21]	Cross sectional	1552 clinical adults	Non-randomised groups	To compare attitudes of overweight (OW) and normal weight (NW) adults regarding health club exercise.
Nuviala et al. [22]	Cross sectional	642 non-clinical adults	Not applicable	To identify the reasons for attrition given by customers who quit their memberships at sports centres, and whether reasons are related to duration of membership
Nuviala et al. [23]	Cross sectional	547 non-clinical adults	Not applicable	To design, to validate and to verify the reliability of a useful instrument as way of evaluation of the motives of the dropout of the organized PA that provide the different sport centres.
Pridgeon and Grogan [24]	Qualitative research	14 non-clinical adults	Not applicable	To investigate experiences of maintaining and dropping out of a gym-based exercise programme
Pope and Harvey [25]	RCT	117 non-clinical adults	Randomised groups	To determine whether fitness-center attendance established with the provision of weekly monetary incentives persisted after the discontinuation, or decreased frequency, of incentives.
Schroeder et al. [26]	Quasi-experimental	405 non-clinical adults	Non-randomised groups	To determine the strength (magnitude) of the associations of the status and duration of a health club membership with the likelihood of meeting the aerobic and/or muscle-strengthening PAG, lifestyle PA levels, sedentary time, and cardiovascular health outcomes
Teychenne et al. [27]	RCT	318 clinical middle aged and older women	Randomised groups	To compare the effectiveness of a standard ST program (SST) to an enhanced program (EST) on the adoption and maintenance of ST and cardio-metabolic risk factors and muscle strength.
Verhoef et al. [28]	Cross sectional	1025 non-clinical adults	Non-randomised groups	To study the cost-effectiveness (in terms of the incremental cost per quality-adjusted life-year (QALY) gained) of the third (most recent) incarnation of the Give it a Go scheme
Zarotis and Arvantidou [29]	Qualitative research	225 non-clinical adults	Not applicable	To study if various reasons for quitting activity in a gym are age-dependent
Zarotis et al. [30]	Qualitative research	225 non-clinical adults	Not applicable	To study how strong are the various reasons for abandoning activities in a fitness studio

App2-Table 5. Manuscript review for the second search criterion (*revisions addressing physical inactivity [physical activity / exercise] or identifying effective methods to enhance physical activity/exercise in adults*)

Authors	Revision type	Main objective	Population	Behaviour change science
Avery et al. [31]	Systematic review	To explore which behaviour change techniques and other intervention features are associated with increased levels of physical activity and improved HbA1c in adults with Type 2 diabetes.	Adults with Type 2 diabetes	Behaviour Change Techniques (BCTs)
Ashford et al. [32]	Systematic review and meta-analysis	To fill the gap of self-efficacy in physical activity interventions by systematically gathering intervention studies which aimed to increase self-efficacy for physical activity	Non-clinical adults	Self-efficacy
Bishop, et al. [33]	Systematic review	To describe and explore the effects of contextual and behaviour change technique (BCT) content of control and target interventions in clinical trials	Clinical adults	Behaviour Change Techniques
Burgess et al. [34]	Systematic review and meta-analysis	To determine if behavioural treatment strategies (e.g., goal setting, motivational interviewing, relapse prevention, cognitive restructuring etc.) improve adherence to lifestyle intervention programmes in adults with obesity.	Adults with obesity	Analysis of different behaviour change approaches
Conn et al. [35]	Meta-analysis	To estimate the overall effect of interventions and, to conduct moderator analyses to identify intervention characteristics associated with the best outcomes	Non-clinical adults	None
Cradock et al. [36]	Systematic review and meta-analysis	To identify the Behaviour Change Technique and intervention features of dietary and physical activity interventions that are associated with changes in HbA_{1c} and body weight	Adults type 2 diabetes	Behaviour Change Techniques (BCTs)
de Vries, et al. [37]	Systematic review and meta-analysis	To know if a behavioural physical activity intervention with an activity monitor increases physical activity	Adults with overweight or obese	Unclear
French et al. [38]	Systematic review	To identify behaviour change techniques (BCTs) that increase self-efficacy and physical activity behaviour in non-clinical community-dwelling adults 60 years or over.	Older adults	Behaviour Change Techniques (BCTs)
Glowacki et al. [39]	Scoping review with systematic searches	To identify barriers and facilitators to exercise and physical activity participation among individuals with depression	Adults with depression	Theoretical Domains Framework
Higgins, et al. [40]	A meta-analysis	To quantify the effect of interventions to increase physical activity among healthy adults on exercise task (EXSE) and barrier self-efficacy (BSE) via meta-analysis	Non-clinical adults	Exercise task and self-efficacy
Hobbs et al. [41]	Systematic review and meta-analysis	To synthesize the evidence from randomized controlled trials (RCT) on the effectiveness of interventions to promote long-term PA change (≥ 12 months) in adults aged 55 to 70 years	Non-clinical adults (55-70 years)	None
Horne et al. [42]	Systematic review	To identify interventions aimed at increasing physical activity (PA) levels among South Asian (SA) adults and identify the specific changes in the content and delivery mode of interventions designed to increase PA levels among SA people aged ≥18 years	Non-clinical adults	None
Knitte et al. [43]	Systematic review and meta- analyses	To identify features of physical activity interventions associated with favourable changes in three prominent motivational constructs: intention, stage of change and autonomous motivation	Adults (no health restrictions)	BCTs, Behaviour Change Techniques and other behaviour change factors
Lambert et al. [44]	Systematic review	to identify and summarise (using the NIH BCC framework) how behavioural interventions to promote physical activity in adults have conceptualised and measured fidelity	Non-clinical adults	None
Muller-Riemenschneider, et al. [45]	Systematic review	to evaluate the long-term effectiveness of physical activity interventions targeted at healthy adults and to identify effective intervention components	Non-clinical adults	None

Murray et al. [46]	Systematic review and meta- analyses	To examine the effectiveness of PA interventions for behaviour change maintenance in young and middle-aged adults, and investigated which Behaviour Change Techniques (BCTs) and other intervention features were associated with maintenance	Young and middle aged non-clinical adults	Behaviour Change Techniques and other behaviour change factors
Murray et al. [47]	Systematic review	To investigate mediators of physical activity maintenance	Young and middle aged non-clinical adults	Different behaviour change frameworks
Nyman et al. [48]	Systematic review	to systematically review the evidence for the potential promise of behaviour change techniques (BCTs) to increase physical activity among people with dementia (PWD).	Adults with dementia	Behaviour Change Techniques
O' Brian, et al. [49]	Systematic review and meta- analyses	to identify intervention features (content and delivery) related to long-term effectiveness in middle aged and older adults	Middle aged and older non-clinical adults	Behaviour Change Techniques and other behaviour change factors
Pears et al. [50]	Systematic review but also randomised controlled trial	to identify and develop promising very brief interventions (VBIs) for physical activity and test their feasibility and acceptability in the context of preventive health checks in primary care	Non-clinical adults	None
Rhodes and Pfaeffli [51]	Literature review	to update the understanding of determinants of Physical activity that include proposed mediators of behaviour change	Non-clinical adults	Different behaviour change frameworks
Samdal et al. [52]	Systematic review and meta-regression analyses	to explain the heterogeneity in results of interventions to promote physical activity and healthy eating for overweight and obese adults, by exploring the differential effects of behaviour change techniques (BCTs) and other intervention characteristics.	Overweight and obese adults	Behaviour Change Techniques
Scarapicchia [53]	a systematic review of prospective studies	to determine the direction and strength of the prospective relationship between social support and PA among healthy adults	Non-clinical adults	Different behaviour change frameworks
Schoeppe et al. [54]	Systematic review	To examine the efficacy of interventions that use apps to improve diet, physical activity and sedentary behaviour in children and adults.	Non-clinical children and adults	Behaviour Change Techniques
Seppälä et a. [55]	Review of policy papers	To identify targets, mediators, and change strategies for physical activity (PA) and nutrition behaviour change in Finnish policy papers on workplace health promotion	Non-clinical adults	Behaviour Change Wheel
Williams and French [56]	Systematic review	To estimate the association between specific intervention techniques used in physical activity interventions and change obtained in both self-efficacy and physical activity behaviour	Non-clinical adults	Behaviour Change Techniques

App2-Table 6. Manuscript review for the third search criterion (r*esearch interventions targeting physical inactivity or exercise in non-clinical adults / interventions using the behaviour change wheel in any adult population for promoting physical activity*)

Authors	Type of study	Sample characteristics	Groups	Intervention type
Aparicio-Ting et al. [57]	RCT	320 non-clinical postmenopausal women	Randomised groups	To compare RPA in postmenopausal women in the exercise group and the control group 12 months after the end of the Alberta Physical Activity and Breast Cancer Prevention (ALPHA) Trial; and 2) To apply the Theory of Planned Behaviour (TPB) to identify predictors of RPA 12 months post-intervention among women in the exercise group
Block et al. [58]	RCT	787 non-clinical adults	Randomised groups	To describe the components and behavioural principles underlying Alive!, and (2) to report effects of the intervention on the secondary outcomes: health-related quality of life, presenteeism, self-efficacy, and stage of change.
Carraça et al. [59]	Cross sectional	5205 non-clinical adults	None	To identify individual-level and environmental-level characteristics of individuals with little or no interest in physical activity
Chatfield and Hallam [60]	Qualitative research	Three non-clinical males (60-65 years)	None	To add to the published health behaviour research reports guided by IPA
Glynn et al. [61]	RCT	90 non-clinical adults	Randomised groups	To evaluate the effectiveness of a smartphone application (app) to increase physical activity in primary care.
Godino et al. [62]	RCT	466 non-clinical adults	Randomised groups	To test whether the observed effects differed according to three different types of feedback that contained visual images and goal setting by way of behavioural modelling, each of which has evidence of effectively motivating behaviour change
Howlett et al. [63]	Other	186 non-clinical adults	None	To empirically validate the constructs of the COM-B model in relation to physical activity in a healthy adult sample
Michie et al. [64]	Other	Not applicable	Not applicable	To develop and test a methodology for linking BCTs to their mechanisms of action
Papandonatos et al. [65]	RCT	239 non-clinical adults	Randomised groups	To examine putative mediators of a 12-month motivationally tailored physical activity (PA) promotion intervention

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Appendix 3. Statements from focus groups gathered into themes

App3-Table 1 displays the statements from focus groups gathered into themes. This process was performed before drafting the first version of the questionnaire, which was subsequently reviewed by the expert panel.

App3-Table 1. Statements from focus groups gathered into themes

Themes	Statements
Do not know how to start exercising in a fitness centre	➢ From the beginning, I wanted to swim as it is the only activity I know how to perform ➢ I do not know who I need to ask about getting advice about which exercise I can do ➢ I do not know if I can get a structured exercise program based on my current health status ➢ Therefore, I never use GOfit because I have no idea what I can do there ➢ I know there are many different offers for doing sports but how do I access them? ➢ I know I can exercise in the fitness room but I do not know how to reach there and how to use the equipment available ➢ I know I can exercise in the fitness room but I do not know how to reach there and how to use the equipment available ➢ I do not dare to ask someone how to use some basic stuff like the treadmill ➢ I would need someone who helps me to start, help me to know how to move around the centre because it is too big ➢ I do not know how to book activities and all these stuff ➢ I acknowledge that I do not know where start doing exercise ➢ And of course, I would need to know what I have to do any time I access the gym ➢ An injury in my shoulder does not allow me to swim so I do not know what exercise I can do ➢ If someone told me which exercises I can perform, I would definitely do them ➢ Therefore, I never use GOfit because I have no idea what I can do there ➢ I do not know who I need to ask about getting advice about which exercise I can do ➢ I do not know if I can get a structured exercise program based on my current health status ➢ I know there are many different offers for doing sports but how do I access them? ➢ I am sure that as soon as I know how to move in Gofit and book the classes I like I will be constant ➢ Finally having no an exercise program that likes me takes my motivation away because when I go there I think, well what I should do now ➢ In other places with a small closed exercise group was easier for me, but any time I come to GOfit with my wife and daughters I feel so embarrassed that I just leave ➢ In my case, my family and workmates encourage me to exercise, but the fear to make a fool keeps me from exercising
Do not know how to perform safe some exercises	➢ Sometimes I don't know how to perform the planned exercises ➢ Sometimes I do not feel safe when I do some classes because there are too many people to get feedback from the trainer ➢ I need to feel safe when I am exercising or I quit ➢ Having the way to perform the exercise in the mobile is ok, but sometimes I need more than an explicative video ➢ Having interesting and funny exercise services that make me workout my body safely and effectively would help me to do sports frequently ➢ From the beginning, I wanted to swim as it is the only activity I know how to perform ➢ I do not feel confident enough to exercise on my own ➢ My problem is I have never done weight exercise before and I do not know even how to use a bike works so if someone taught me I would give it a try ➢ I know that the main factor that keeps me from exercising is my lack of knowledge about what I can do to be healthy ➢ I want to exercise without feeling I am going to get injured ➢ One of my main problems is that I need someone who teaches me how to perform right some exercises, at least the first time ➢ I do not feel safe when I exercise in fitness room because trainers never correct me ➢ I am sure there are many exercises I should do better, but most of the time I cannot ask for assistance ➢ It is not just see how to perform an exercise, but also to know the common mistakes and know which things I must control to do the exercise right and safe ➢ The lack of knowledge about what I can do in GOfit is the main reason that keeps me from exercising

	➢ I check the exercises on my mobile but those I have never done before I need something else ➢ I am too shy to try to do some exercises or use machines without knowing how it works ➢ I do not dare to ask someone how to use some basic stuff like the treadmill ➢ I want to exercise without feeling I am going to get injured ➢ It would be nice that first time I do exercise trainers take the pain to teach me and tell me the things I must consider ➢ If someone told me which exercises I can perform, I would definitely do them ➢ I do not like when I just get an exercise program and that's all, at the beginning I need some help and advice to perform it
Do not know how to use the equipment available/access classes	➢ I know I can exercise in the fitness room but I do not know how to reach there and how to use the equipment available ➢ My problem is I have never done weight exercise before and I do not know even how to use a bike works so if someone taught me I would give it a try ➢ I do not know how to book activities and all these stuff ➢ I do not dare to ask someone how to use some basic stuff like the treadmill ➢ I do not dare to ask someone how to use some basic stuff like the treadmill
Do not understand the reason of some exercises / find them too standards	➢ I want to know what is best for me and why I must do some exercises, not only do what I want because I do not know ➢ I just felt I was given a standard exercise program and I never was explained why the trainer picked these exercises for me ➢ But I need an individualised exercise program, not something too standard, It must be based on my tastes ➢ I got an exercise program twice and they were boring, standard and not easy to perform on my own ➢ I can be consistent with my exercise program, but only if connect with it otherwise I will not engage in the activity ➢ Having interesting and funny exercise services that make me workout my body safely and effectively would help me to do sports frequently ➢ Moreover, I need to feel that the exercise I am performing is truly effective to increase my fitness ➢ I want to know what is best for me and why I must do some exercises, not only do what I want because I do not know
Do not know which exercise should do every week and how much exercise/why this exercise is important	➢ I know doing sports is good for my health, but I am not sure about the best exercises for increasing my health ➢ Having someone who guides me, who told me what I should do each week would help me as I am a good pupil ➢ I know that the main factor that keeps me from exercising is my lack of knowledge about what I can do to be healthy ➢ In short, I do not know which exercise is good for my health, how much exercise and what sort of exercise I should do to be healthy ➢ I am not totally sure which characteristics should have my exercise program, but I know what am looking for ➢ I am not sure what characteristics should have my exercise program ➢ It would be fantastic for me to get the advice of one expert who explain my why I should do some exercises ➢ I mean not only someone who told me, these are the classes available and the machines, but who advise me what is best for me ➢ I acknowledge that I have no clue about what should include my exercise program to remain healthy, but no one informed me ➢ Also receiving advice about which exercise type is best for me would encourage me ➢ I want to know what is best for me and why I must do some exercises, not only do what I want because I do not know ➢ If I had someone as a reference who guide me and help to understand what I really need to do to remain healthy would help me a great deal ➢ I am not asking for a personal trainer, this is something else, it is just having someone who tells me "you must exercise every M, X and T at 7:00 am" and check my progress occasionally ➢ I know that I must do some cardiovascular and endurance exercise, but not how to combine them and the minimum required per week
Lack of energy or too tired to exercise	➢ When I finish my job I am too tired and I don't fancy exercise at GOfit so I just go home ➢ Most of the time I did not exercise as planned was because I was lack of energy ➢ Sometimes I just finish the job so exhausted that I do not fancy exercising at all ➢ The main issue is the laziness I feel ➢ My problem is that I lost the rhythm so laziness is increasing when it comes to exercising

	➢ I think that the laziness when I am tired keeps me from exercising
Have some physical/fitness limitation to exercise	➢ I am not sure if I am fit enough to face even the level 1 of some classes ➢ I think I am not fit enough to exercise well, so for instance just resting on the treadmill is so embarrassed for me ➢ I do not feel confident enough to exercise on my own
Unable to cope with an open schedule to exercise	➢ Having close days for exercising would be a great idea, I mean I could just arrange it in my personal schedule ➢ Moreover, in my case, I need to have a fixed schedule to organise my life too much freedom doesn't fit with me ➢ Moreover, sometimes I am unable to organise my schedule to find time to exercise ➢ Having an open schedule keeps me from exercising because I always say, well, do it later or I just leave it for tomorrow ➢ Moreover, having a fixed schedule would force me to bring the sports clothes to job ➢ Having close days for exercising would be a great idea, I mean I could just arrange it in my personal schedule ➢ I need to arrange my exercise time in my schedule and someone who forced me to commit to it to become it in a routine ➢ Having a closed schedule would force me to exercise the planned days as I could not do it any other day ➢ I need to set the exercise time in my schedule to force me to exercise
Need to commit to do the behaviour and deal with external factors	➢ My mother also takes much time from me, but if I commit with exercise I am sure I could handle it better ➢ Of course, the daily responsibilities reduce my free time but I think I would deal with it if I committed with the exercise ➢ I like the opened schedule but committing to exercising a number of days per week, it definitely would help me ➢ Of course, the daily responsibilities reduce my free time but I think I would deal with it if I committed with the exercise ➢ It would be good for me to commit to exercise always the same days and schedule and only swap dates when I have no other options. It would help me to organise my life ➢ Commit to a structured exercise program would help me a great deal ➢ Also having someone as the reference would help me to commit with the exercise ➢ I need to arrange my exercise time in my schedule and someone who forced me to commit to it to become it in a routine ➢ Also would be great if I could commit to an specific exercise schedule and the mobile follow up my attendance rate ➢ I think that if I committed to some timetable would help me to exercise more frequently as helps me to organise my weekly schedule
Think they can cope with external stuffs and exercise more/can acquire the habit	➢ Some daily stuff reduce my free time, but I am sure I could manage ➢ Also, other daily responsibilities reduce my time but I could find the way to manage ➢ My mother also takes much time from me, but if I commit with exercise I am sure I could handle it better ➢ I need inertia to take the habit. I can get used to a new habit ➢ I want to engage in regular sport and I think I can do it ➢ I used to do so much sport so I thought it was a great opportunity to restart ➢ I always use the excuse I do not have time because I work quite a lot, but I know I could find time ➢ Of course, the daily responsibilities reduce my free time but I think I would deal with it if I committed with the exercise ➢ I just need the right push to get the habit ➢ I enrolled in GOfit because I used to do so much sport in my life and I want do it again
Unable to priorise sports over other stuffs	➢ I was able to exercise frequently some months ago and I felt good, but for some reasons, I had to reduce the time and I lost the rhythm ➢ I expected to come almost every Monday to Friday but I was unable to engage ➢ I am unable to prioritize exercise over some non-important stuff ➢ My main issue is I do not find the way to be constant ➢ I acknowledge I am lazy so that's why sports is not a priority ➢ In general, I know I always find a pretend for not exercising ➢ I could find at least 2-3 days per week to exercise, just need a push

	➢ I am still trying to get the exercise routine that helps me to feel better but it is hard to engage
DO not have objectives	➢ I think that having real objectives and a follow-up table would help me to exercise ➢ When I exercise I do not look at the outcomes, Just doing Pilates for one hour makes me happy
Need an external supervisor/follow-up	➢ I am sure that being supervised by someone would help me to be more constant ➢ I understand I must exercise on my own, but I would need someone who follows-up my progress occasionally (not after so much time) ➢ But I think that overall what I need is a bond with a trainer who follows-up me but not every three months ➢ I would like to have someone who follows-up on my progress, understand my needs and occasionally check and update my program ➢ Failing someone who is supervising me is too embarrassed for me so it definitely will work for me ➢ It would be nice to have someone who supervise my progress occasionally ➢ I mean having some reference trainer, who always is the same person. Like when you are doing some diet ➢ Also, analysing my progress with someone from time to time would help me as I would feel embarrassed if I did not workout ➢ Someone who helps me to find reasons to engage in regular exercise would help me ➢ But I need a follow up as well, I mean not just repeat the same without a sense ➢ Having a reference person would force me to exercise more, I am sure of that ➢ If I know the day I must exercise and I know my reference person is there to help me I would try to exercise for sure ➢ If someone tells me "you must be here every day at 6:00 pm and do these exercises I would be here every day at 6:00 performing these exercises ➢ But I need a follow up as well, I mean not just repeat the same without a sense ➢ I am not asking for a personal trainer, this is something else, it is just having someone who tells me "you must exercise every M, X and T at 7:00 am" and check my progress occasionally ➢ I know I just need someone I rely on helps me to know how to behave in the gym
Lives/work near to my fitness centre	➢ I live 5 minutes away from the GOfit so coming here do not takes me so much time ➢ I live near to the Gofit so I can come any time I want ➢ I just enrolled because GOfit is close to my home
Wide schedule to exercise/open schedule to exercise	➢ GOfit owns a wide timetable and I thought it would help me to be more constant ➢ Having a closed schedule would force me to exercise the planned days as I could not do it any other day ➢ The extended schedule to exercise was also a reason to enrolled ➢ Also would be great if I could commit to an specific exercise schedule and the mobile follow up my attendance rate ➢ I need to arrange my exercise time in my schedule and someone who forced me to commit to it to become it in a routine ➢ Having close days for exercising would be a great idea, I mean I could just arrange it in my personal schedule ➢ Moreover, in my case, I need to have a fixed schedule to organise my life too much freedom doesn't fit with me ➢ Having an open schedule keeps me from exercising because I always say, well, do it later or I just leave it for tomorrow ➢ Moreover, having a fixed schedule would force me to bring the sports clothes to job
The exercise time can be set in their personal schedule	➢ Having a closed schedule would force me to exercise the planned days as I could not do it any other day ➢ Also would be great if I could commit to an specific exercise schedule and the mobile follow up my attendance rate ➢ I need to arrange my exercise time in my schedule and someone who forced me to commit to it to become it in a routine ➢ Having close days for exercising would be a great idea, I mean I could just arrange it in my personal schedule ➢ Moreover, in my case, I need to have a fixed schedule to organise my life too much freedom doesn't fit with me ➢ Having an open schedule keeps me from exercising because I always say, well, do it later or I just leave it for tomorrow ➢ Moreover, having a fixed schedule would force me to bring the sports clothes to job
Available exercises programs,	➢ I never got offered an individualised exercise program

but need improvement	➢ But I need an individualised exercise program, not something too standard, It must be based on my tastes ➢ Having a standardised program will help me of course
Can afford the membership fee	➢ The membership fee is not a big expense to me ➢ The main reason to enrol is that the familiar membership is cheap
Many exercises/classes offer to workout	➢ GOfit offers several activities I like, including a swimming pool ➢ I know there are many different offers for doing sports but how do I access them? ➢ I know I can exercise in the fitness room but I do not know how to reach there and how to use the equipment available ➢ I enrolled because I thought that having a large exercise offer would help me to be constant ➢ I enrolled because I thought that having these amount of activities would encourage me to exercise almost every day
Possibility to exercise in group	➢ I want to do sports in a group rather than alone ➢ Some of the available exercise services cannot be named as GOfit does. Doing Pilates or Yoga together with 30 people is not pilates ➢ I did spinning in the past, so I thought I also would it in Gofit
Additional services	➢ I like the newsletter from GOfit even though I do not exercise frequently, I usually read them to know more about healthy lifestyles ➢ I am aware that GOfit offers several additional services I do not use, like physiotherapy or nutrition, but I like it
Characteristics that the exercise program/exercise services should fulfil	➢ I need my exercise program to be flexible enough and not only includes something else, like HIIT, not only weight exercise in machines ➢ To enjoy an exercise program, it must be fun and easy to perform on my own. Moreover, it must be updated frequently ➢ I do not connect to the current GOfit services so I do not feel like exercise there. I find them too boring ➢ I never got offered an individualised exercise program ➢ But I need an individualised exercise program, not something too standard, It must be based on my tastes
Need to enough equipment	➢ One time I tried to test a class in which participants use some special boots to jump I couldn't because there were not boots of my size
Prompt and cues	➢ Also, It is good when I received some email when I stopped to exercise because I felt bad with my self and encourage me to go back ➢ I think that some Push when I fail would help me to re-enlist ➢ Some alarm in my mobile that remind me when is exercise time would be great ➢ More information about the special activities like when GOfit organises some routes around the mountain would help me to engage
Influence of Job to exercise	➢ My job sometimes conditionates my time for exercising, but it is because I am tired ➢ I always use the excuse I do not have time because I work quite a lot, but I know I could find time ➢ Work frequently keeps me from exercising (i.e. I do not like my last job and I spent my free time finding a new one) ➢ My job and family are not a problem to exercise is that I do not know where to start ➢ The main reason that keeps me from exercising is my Job
Influence of close people to exercise	➢ My mother also takes much time from me, but if I commit with exercise I am sure I could handle it better ➢ In my case, my family and workmates encourage me to exercise, but the fear to make a fool keeps me from exercising ➢ My wife and daughters use the gym quite a lot so I hope this encourages me ➢ Sometimes my friends do not understand I expend so much time exercising in the gym (they even told me, "came on mate, you are obsessed with gym") ➢ My job and family are not a problem to exercise is that I do not know where to start
Influence of daily responsibilities	➢ Also, other daily responsibilities reduce my time but I could find the way to manage ➢ Of course, the daily responsibilities reduce my free time but I think I would deal with it if I committed with the exercise ➢ Also, other daily responsibilities reduce my time but I could find the way to manage ➢ Some daily stuff reduce my free time, but I am sure I could manage
A follow-up system	➢ Having a follow up so I can get new exercises and meet some milestones would help a great deal ➢ Also, having a follow-up on my performance with the app that reminds me when it is exercise time would be great

Gamification available	➢ I like the pointing system that Gofit has to reward those who exercise
Want to exercise/intention to workout	➢ I want to do sports because it is important for my health and I almost do not exercise at all ➢ I want to do some sport, but I do not use GOfit it as much as I could because I do not enjoy the experience ➢ From the beginning, I wanted to swim as it is the only activity I know how to perform ➢ I want to exercise without feeling I am going to get injured ➢ I truly need an exercise routine based on my shoulder injury ➢ I am willing to wake up early to exercise or go to the gym late, it is just I am unable to engage ➢ I am still trying to engage in an exercise routine once and for all ➢ I am sure that if my exercise routine includes something more like burpees, something enjoyable, would really help me to engage ➢ I enrolled because I thought that having these amount of activities would encourage me to exercise almost every day ➢ I did spinning in the past, so I thought I also would it in Gofit ➢ I am still trying to find the best exercise routine that suits me and makes me feel better ➢ I used to do so much sport so I thought it was a great opportunity to restart ➢ I want to engage in regular sport and I think I can do it ➢ My experience in GOfit is ok, but I do not find the formula to engage ➢ Moreover, I want to do sport for health reasons, I quit smoke and I gain some weight ➢ I need to become doing exercise as something priority again ➢ I am sure that if my exercise routine includes something more like burpees, something enjoyable, would really help me to engage ➢ I just enrolled because I wanted to start doing some exercise as I am like "a couch" person
Do not feel secure/confident when exercising	➢ To meet with the structured program, it does not only must like me but I need to feel confident enough with it ➢ I need to feel safe when I am exercising or I quit ➢ Having interesting and funny exercise services that make me workout my body safely and effectively would help me to do sports frequently ➢ I need to feel that the exercise I have planned is going to be good for my health ➢ I want to exercise without feeling I am going to get injured ➢ GOfit trainers sometimes are not on the lookout of their customers to correct them when they made some mistake while are exercising ➢ I do not feel safe when I exercise in fitness room because trainers never correct me
Not strong motivation/laziness/boredom, etc.	➢ If I do not like the way the instructor gives the class I do not enjoy the exercise and I quit ➢ I just quit because I do not like the exercise service of Gofit ➢ I hate exercising in fitness room it is too boring for me ➢ Most of the exercise services provided for GOfit are boring ➢ The lack of motivation is my main reason for not working out in Gofit ➢ To enjoy an exercise program, it must be fun and easy to perform on my own. Moreover, it must be updated frequently ➢ I got an exercise program twice and they were boring, standard and not easy to perform on my own ➢ My previous exercise program was far from what I wanted so it never engaged me ➢ Finally having no an exercise program that likes me takes my motivation away because when I go there I think, well what I should do now ➢ Sometimes I just finish the job so exhausted that I do not fancy exercising at all ➢ My problem is that I see doing sports as an obligation (lose weight, because it is healthy) so I always find an excuse to set it aside ➢ I know that laziness is my main reason for not exercising ➢ Most of the time I do not see the reason to perform one exercise so I just lose my motivation ➢ The problem is that sometimes I just reach home from work at 8 and I do not fancy doing nothing at all

	➢ The main issue is the laziness I feel ➢ In the end, I always find an excuse for not exercising ➢ But must be always the same person I do not want to tell my personal issues to everyone ➢ The problem is like swimming but when I can swim the pool is overcrowded so I lost interest
Gofit scared, intimidates / feeling of being a fool, embarracement	➢ The problem is that I just watch on the screen and see all the classes available that it intimidates me ➢ I like to exercise on my own and here I just feel observed ➢ I know I just need to face my fears to start but it is hard ➢ I am a shy person and looking around and see all these amounts of fit people… ➢ I am a routine person, but I need to start to engage but I feel embarrassment ➢ I never went through the turnstile because the centre is that big that intimidates me ➢ I feel stupid when I am in GOfit because I do not know how to use the equipment I have in front of me ➢ Moving around the gym intimidates me, I just feel I do not know what to do
Need understand the meaning of the planned exercise/it must be worth it	➢ Having interesting and funny exercise services that make me workout my body safely and effectively would help me to do sports frequently ➢ I need to feel that the exercise I have planned is going to be good for my health ➢ Moreover, I need to feel that the exercise I am performing is truly effective to increase my fitness ➢ Finally having no an exercise program that likes me takes my motivation away because when I go there I think, well what I should do now ➢ Most of the time I do not see the reason to perform one exercise so I just lose my motivation ➢ A structured exercise program that I understand the reason of each exercise is what I need, definitely
Did enjoy/ did not enjoy the experience	➢ I like the swimming pool and collective classes, but I hate doing strength exercises ➢ I got an exercise program twice and they were boring, standard and not easy to perform on my own ➢ The experience in GOfit is good and I enjoy when I exercise there, but I cannot engage in a routine ➢ I got an exercise program twice and they were boring, standard and not easy to perform on my own ➢ My previous exercise program was far from what I wanted so it never engaged me ➢ Some of the available exercise services cannot be named as GOfit does. Doing Pilates or Yoga together with 30 people is not pilates ➢ My experience in GOfit is ok, but I do not find the formula to engage
Need to like/enjoy/connect with the proposed exercise program to follow it	➢ To meet with the structured program, it does not only must like me but I need to feel confident enough with it ➢ Having interesting and funny exercise services that make me workout my body safely and effectively would help me to do sports frequently ➢ To enjoy an exercise program, it must be fun and easy to perform on my own. Moreover, it must be updated frequently ➢ I am sure that if my exercise routine includes something more like burpees, something enjoyable, would really help me to engage ➢ Finally having no an exercise program that likes me takes my motivation away because when I go there I think, well what I should do now
Need extrinsic motivation to engage/future emotions	➢ Also, It is good when I received some email when I stopped to exercise because I felt bad with my self and encourage me to go back ➢ Having a follow up so I can get new exercises and meet some milestones would help a great deal ➢ Also, analysing my progress with someone from time to time would help me as I would feel embarrassed if I did not workout ➢ I only was consistent doing exercise when I had a personal trainer, but because it was that expensive that I could not afford not using it ➢ It would be great if I could commit myself to a schedule to exercise, I mean having a closed schedule (i.e. Monday at 17:00)
Exercise is not a priority even though they want do it	➢ Exercising is not a priority in my life, so if something goes wrong I just do not do the planned exercise ➢ Moreover, when I have meetings or something unexpected I acknowledge I do set my exercise routine aside ➢ In the end, I always find an excuse for not exercising ➢ I need to become doing exercise as something priority again

Appendix 4. Example of the table that experts had to complete (revision round 4)

The example below corresponds to the table that experts of behaviour change were asked to complete. This tables were completed in round 4.

Section 1: Reflective Motivation

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Totally irrelevant 1	Somehow irrelevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. It is not important to me to be active **Previous version:** I consider doing physical activity to be important in my life *												
2. I am willing to make changes to be exercise more and/or stay active at my fitness centre *												
3. I do not have goals that I want to achieve by exercising at my fitness centre												
4. I do not plan how many times and how much I will exercise at the fitness centre each week **Previous version:** I have goals of how much and how many times I am going to exercise at my fitness centre *												
5. It is important to me to have a programme that guides me on how to exercise at my fitness centre * **Previous version:** I think having an exercise programme helps me to exercise at my fitness centre *												
6. It is important to me to self-monitor my progress *												
7. It is important to me to received feedback on my progress from my fitness centre *												

*: Positive item to be reverse scored

Section 2: Automatic Motivation

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Not relevant 1	Somehow relevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. Most of the time I don't feel like exercising at my fitness centre												
2. I feel I belong when I am in my fitness centres * **Previous version (*previously mapped into reflective motivation*):** I don't think I belong in the environment of my fitness centre												
3. Exercising at my fitness centre is boring for me												
4. I feel intimidated when I go to exercise at my fitness centre **Previous version:** I feel intimidated by the environment when exercising at my fitness centre												
5. I feel good when I exercise at the fitness centre * **Previous version:** I enjoy exercising at my fitness centre *												
6. The thought of being sore or tired due to exercising at my fitness centre keeps me from exercising **(*previously mapped into reflective motivation*)**												

*: Positive item to be reverse scored

Section 3: Social Opportunity

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Not relevant 1	Somehow relevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. Most of the people that matter to me (my family/close friends/partner) are supportive of me exercising at my fitness centre * **Previous version:** The people surrounding me (my family/close friends/partner) are supportive of me exercising at my fitness centre *												
2. If I wanted to, I cannot exercise with others at my fitness centre **Previous version:** If I wanted to, I have people in my fitness centre I could exercise with *												
3. Some people in my social circle frequently exercise at a fitness centre * **Previous version:** Many people in my social network exercise regularly at a fitness centre *												

*: Positive item to be reverse scored

Section 4: Physical Opportunity

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Not relevant 1	Somehow relevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. It is easy for me to get to my fitness centre * **Previous version:** I find it easy to get to my fitness centre *												
2. The hours my fitness centre is open are not convenient for me **Previous version:** The opening hours of my fitness centre are convenient for me *												
3. My fitness centre offers ~~enough~~ exercise options that suit me *												
4. My daily responsibilities hinder me to find the time I need to exercise at my fitness centre												
5. I can book classes or other kind of exercise services in advance if I want to *												
6. I find it hard to take part in the classes and exercise services offered by my fitness centre												
7. Even when the centre is busy, I can access the equipment/classes I need *												
8. if required, my fitness centre provides me with a tailor-made programme to follow *												
9. I cannot discuss my programme with a staff member whenever ~~I want/~~need to												
10. The staff ~~available~~ in my fitness centre are knowledgeable enough to advise me about exercising there *												
11. While I am exercising at my fitness centre, I am not helped/supervised by a member of staff when I need it												

*: Positive item to be reverse scored

Section 5: Physical Capability

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Not relevant 1	Somehow relevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. I do not have any health condition or illness that keeps me from exercising at my fitness centre *												
2. I am not physically able to perform the exercise I plan to do at my fitness centre **Previous version:** I feel physically able to perform the exercises I plan to do *												
3. I often feel like my energy levels are low to go to my fitness centre and exercise **Previous version:** I usually feel too tired or lack energy to go to my fitness centre and exercise												

*: Positive item to be reverse scored

Section 6: Psychological Capability

This section uses the following 6-point Likert Scale	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*	*Not applicable*
	☐	☐	☐	☐	☐	☐

	Mapped into the right category?		Relevance *1 [lower] - 4 [highest]*				Clarity *1 [lower] - 4 [highest]*				Overall satisfaction *1 [lower] - 9 [highest]*	Comments
	Yes	No, move to...	Not relevant 1	Somehow relevant 2	Quite relevant 3	Highly relevant 4	Totally unclear 1	Somehow unclear 2	Quite clear 3	Highly clear 4		
1. I know the health benefits of being physically active *												
2. I can do the exercises included in my programme * **Previous version:** I find it easy to stick to my programme of exercise												
3. I know how active I should be to gain the health benefits related to physical activity *												
4. I am not sure how to use some the equipment at my fitness centre to prevent injuries **Previous version:** I know how to use the equipment at my leisure centre to prevent injuries												
5. I don't know how to do some of the exercises included in my programme **Previous version:** I don't know how to do some of the exercises in my fitness centre exercise plan												
6. I do not understand how some of the exercises in my plan can help me to improve my fitness **Previous version:** I do not understand how some of the exercises in my plan can help me to achieve my goals												

*: Positive item to be reverse scored

Appendix 5. Example of the table that experts had to complete to validate the questionnaire into Spanish

The example below corresponds to the table that experts were asked to complete in the validation of the Exercise Behaviour in Fitness Centres Questionnaire into Spanish. This table is an example of the table that was sent to experts in round 1.

Sección 1: Motivación Reflectiva

Para responder a esta sección se utiliza una escala Likert de 5 puntos	*Totalmente en desacuerdo*	*En desacuerdo*	*Ni de acuerdo ni en desacuerdo*	*De acuerdo*	*Totalmente de acuerdo*	*No aplicable*
	☐	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con la traducción** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
8. Ser activo físicamente no es importante para mi *** Being active is not important to me**												
9. Estoy dispuesto a realizar cambios para hacer más ejercicio y/o ser activo en mi centro de fitness. *** I am willing to make changes to exercise more and/or be active at my fitness centre**												
10. No hay ningún objetivo concreto que quiera lograr al ejercitarme en mi centro de fitness *** I do not have goals that I want to achieve by exercising at my fitness centre**												
11. Cada semana planifico cuántas veces y cuánto tiempo voy a hacer ejercicio en mi centro de fitness * **I plan how many times and how much I will exercise at my fitness centre each week**												
12. Es importante para mí tener un programa que me guíe sobre cómo hacer ejercicio dentro de mi centro de fitness *** Having a programme that guides me on how to exercise at my fitness centre is important to me**												
13. La idea de sentirme cansado o tener agujetas como consecuencia de entrenar en mi centro de fitness hace que no practique ejercicio *** The thought of being sore or tired due to exercising at my fitness centre keeps me from exercising**												
14. Para mí es importante que mi centro de fitness me informe sobre cómo están mejorado mi salud y mi estado físico *** It is important to me to receive feedback from my fitness centre about how my health and fitness are improving**												

Sección 2: Motivación Automática

Para responder a esta sección se utiliza una escala Likert de 5 puntos	*Totalmente en desacuerdo*	*En desacuerdo*	*Ni de acuerdo ni en desacuerdo*	*De acuerdo*	*Totalmente de acuerdo*
	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con la traducción** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
1. La mayoría del tiempo no me apetece hacer ejercicio en mi centro de fitness *** Most of the time I don't feel like exercising at my fitness centre**												
2. Me aburre hacer ejercicio en mi centro de fitness *** Exercising at my fitness centre is boring for me**												
3. Me siento intimidado cuando voy a hacer ejercicio en mi centro de fitness *** I feel intimidated when I go to exercise at my fitness centre**												
4. Me siento bien cuando hago ejercicio en mi centro de fitness *** I feel good when I exercise at the fitness centre**												

Sección 3: Oportunidad Social

Para responder a esta sección se utiliza una escala Likert de 5 puntos	*Totalmente en desacuerdo*	*En desacuerdo*	*Ni de acuerdo ni en desacuerdo*	*De acuerdo*	*Totalmente de acuerdo*
	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con el ítem** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
1. La gente de mi entorno (familiares, amigos cercanos, pareja) apoya que realice ejercicio en mi centro de fitness *** The people that matter to me (my family circle/close friends/partner) are supportive of me exercising at my fitness centre**												
2. Si quiero, puedo entrenar con otros dentro de mi centro de fitness. *** If I want to, I can exercise with others at my fitness centre**												
3. Cuando estoy en mi centro de fitness tengo un sentimiento de pertenencia *** I feel I belong when I am at my fitness centres**												
4. La gente de mi entorno social no realiza ejercicio en centros de fitness *** People in my social circle do not exercise at fitness centres**												

Sección 4: Oportunidad Física

Para responder a esta sección se utiliza una escala Likert de 5 puntos	***Totalmente en desacuerdo***	***En desacuerdo***	***Ni de acuerdo ni en desacuerdo***	***De acuerdo***	***Totalmente de acuerdo***
	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con el ítem** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
1. Para mí es fácil llegar a mi centro de fitness *** It is easy for me to get to my fitness centre**												
2. El horario de apertura de mi centro de fitness es adecuado para mí *** The opening hours of my fitness centre are convenient for me**												
3. Mi centro de fitness ofrece opciones de ejercicio que son atractivas para mi *** My fitness centre offers exercise options that suit me**												
4. Mis responsabilidades diarias me limitan el tiempo que tengo para hacer ejercicio en mi centro de fitness *** My daily responsibilities limit the time I have to exercise at my fitness centre**												
5. Si quiero, puedo reservar clases colectivas u otro tipo de servicios deportivos con antelación *** I can book classes or other kind of exercise services in advance if I want to**												
6. Las clases y opciones de ejercicio están disponibles a diferentes niveles de intensidad y dificultad de forma que puedo participar en ellas independientemente de mi condición física o mis habilidades *** There are classes and exercise options available at different levels of intensity and difficulty so that I can take part in regardless of my ~~own~~ fitness level or ability**												
7. Incluso cuando el centro está lleno, puedo acceder a las clases o al equipamiento que quiero * **Even when my fitness centre is busy, I can access the equipment/classes I want**												
8. Si lo solicito, mi centro deportivo me proporciona un plan de ejercicio hecho a mi medida *** If required, my fitness centre provides me with a tailor-made programme to follow**												
9. No puedo revisar mi programa de ejercicios con un miembro del staff cuando quiero/lo necesito *** I can't discuss my programme with a staff member when I want/need to**												
10. El personal presente en mi centro de fitness es capaz de aconsejarme sobre cómo hacer ejercicio allí * **Staff at my fitness centre are able to advise me about exercising there**												
11. No puedo recibir la ayuda o supervisión de un miembro del personal presente cuando lo necesito *** I can't get help or supervisionfrom staff when I need it**												

Sección 5: Capacidad Física

Para responder a esta sección se utiliza una escala Likert de 5 puntos	***Totalmente en desacuerdo***	***En desacuerdo***	***Ni de acuerdo ni en desacuerdo***	***De acuerdo***	***Totalmente de acuerdo***
	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con el ítem** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
1. No tengo ningún problema de salud o enfermedad que me impida realizar ejercicio en mi centro de fitness *** I do not have any health condition or illness that keeps me from exercising at my fitness centre**												
2. No soy físicamente capaz de realizar los ejercicios incluidos en mi programa de ejercicios *** I am not physically able to perform the exercises included in my programme**												
3. Siento que mis niveles de energía están demasiado bajos como para ir a hacer ejercicio a mi centro de fitness *** I feel like my energy levels are too low to go to my fitness centre and exercise**												

Sección 6: Capacidad Psicológica

Para responder a esta sección se utiliza una escala Likert de 5 puntos	*Totalmente en desacuerdo*	*En desacuerdo*	*Ni de acuerdo ni en desacuerdo*	*De acuerdo*	*Totalmente de acuerdo*
	☐	☐	☐	☐	☐

	Hoja de feedback											
	¿La traducción mantiene la semántica original?		**Nivel de la traducción** *1 [baja] - 4 [alta]*				**Claridad y facilidad para entender el ítem por hispanoparlantes** *1 [baja] - 4 [alta]*				**Satisfacción general con el ítem** *1 [baja] - 9 [alta]*	**Comentarios**
	Sí	**No**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**		
1. Conozco los beneficios que tiene para la salud ser físicamente activo *** I know the health benefits of being physically active**												
2. Sé cómo de activo debo ser para obtener los beneficios de salud relacionados con la actividad física *** I know how active I should be to gain the health benefits related to physical activity**												
3. Es importante para mí poder autorregistrar/monitorizar cuánto ejercicio hago en mi centro de fitness *** It is important to me to self-monitor how much exercise I do at my fitness centre**												
4. No sé cómo utilizar de forma segura el equipamiento de mi centro de fitness *** I do not know how to use safely the equipment at my fitness centre**												
5. No sé cómo realizar los ejercicios incluidos en mi programa de ejercicios *** I do not know how to do the exercises included in my programme**												
6. No entiendo cómo los ejercicios de mi programa de ejercicios me pueden ayudar para mejorar mi condición física *** I do not understand how the exercises in my programme can help me to improve my fitness**												

Appendix 6. Expert's approved version of the Exercise Behaviour in Fitness Centres Questionnaire

There are many reasons why someone does or does not exercise. The factors listed below will help us to understand which elements are important for people to exercise. We know that some of the items might look strange, but it is because we need to include anything that might possibly apply to some people.

Section 1: Reflective Motivation

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	***Strongly disagree***	***Disagree***	***Neither agree or disagree***	***Agree***	***Totally agree***
15. Being active is important to me	☐	☐	☐	☐	☐
16. I am willing to make changes to exercise more and/or be active at my leisure centre *	☐	☐	☐	☐	☐
17. I do not have goals that I want to achieve by exercising at my leisure centre	☐	☐	☐	☐	☐
18. I plan how many times and how much I will exercise at my leisure centre each week *	☐	☐	☐	☐	☐
19. Having a programme that guides me on how to exercise at my leisure centre is important to me *	☐	☐	☐	☐	☐
20. The thought of being sore or tired due to exercising at my leisure centre keeps me from exercising	☐	☐	☐	☐	☐
21. It is important for me to receive feedback from my leisure centre about how my health and fitness are improving *	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Section 2: Automatic Motivation

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	***Strongly disagree***	***Disagree***	***Neither agree or disagree***	***Agree***	***Totally agree***
1. I don't feel like going to my leisure centre to exercise	☐	☐	☐	☐	☐
2. Exercising at my leisure centre is boring for me	☐	☐	☐	☐	☐
3. I feel intimidated when I exercise at my leisure centre	☐	☐	☐	☐	☐
4. I feel good when I exercise at my leisure centre *	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Section 3: Social Opportunity

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	***Strongly disagree***	***Disagree***	***Neither agree or disagree***	***Agree***	***Totally agree***
1. The people that matter to me (my family circle/close friends/partner) are supportive of me exercising at my leisure centre *	☐	☐	☐	☐	☐
2. If I wanted to, I could exercise with others at my leisure centre *	☐	☐	☐	☐	☐
3. I feel I belong when I am at my leisure centre *	☐	☐	☐	☐	☐
4. People in my social circle do not exercise at leisure centres	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Section 4: Physical Opportunity

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	***Strongly disagree***	***Disagree***	***Neither agree or disagree***	***Agree***	***Totally agree***
1. It is easy for me to get to my leisure centre *	☐	☐	☐	☐	☐
2. The opening hours of my leisure centre are convenient for me *	☐	☐	☐	☐	☐
3. My leisure centre offers exercise options that suit me *	☐	☐	☐	☐	☐
4. My daily responsibilities limit the amount of time I have to exercise at my leisure centre	☐	☐	☐	☐	☐
5. I can book classes or other kinds of exercise services in advance if I want to *	☐	☐	☐	☐	☐
6. There are classes available or other exercise options ranked by intensity and difficulty so I can take part in them regardless of my fitness level or ability	☐	☐	☐	☐	☐
7. Even when my leisure centre is busy, I can access the equipment/classes I want *	☐	☐	☐	☐	☐
8. If required, my leisure centre provides me with a tailor-made programme to follow *	☐	☐	☐	☐	☐
9. I can't discuss my programme with a staff member when I want/need to	☐	☐	☐	☐	☐
10. Staff at my leisure centre are able to advise me about exercising there *	☐	☐	☐	☐	☐
11. I can't get help or supervision from staff when I need it	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Section 5: Physical Capability

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*
1. I do not have any health condition or illness that keeps me from exercising at my leisure centre *	☐	☐	☐	☐	☐
2. I am not physically able to perform the exercises included in my programme	☐	☐	☐	☐	☐
3. I often feel like my energy levels are too low to go to my leisure centre and exercise	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Section 6: Psychological Capability

Please, answer strongly disagree when the sentence does not apply to you at all and, answer totally agree when the sentence applies totally to you.	*Strongly disagree*	*Disagree*	*Neither agree or disagree*	*Agree*	*Totally agree*
1. I know the health benefits of being physically active *	☐	☐	☐	☐	☐
2. I know how active I should be to gain the health benefits related to physical activity *	☐	☐	☐	☐	☐
3. It is important for me to self-monitor how much exercise I do at my leisure centre *	☐	☐	☐	☐	☐
4. I do not know how to safely use the equipment at my leisure centre	☐	☐	☐	☐	☐
5. I do not know how to do the exercises included in my programme	☐	☐	☐	☐	☐
6. I do not understand how the exercises in my programme can help me to improve my fitness	☐	☐	☐	☐	☐

*: Positive item to be reverse scored

Appendix 7. Methodology of the pragmatic review conducted in Chapter 5

The searching process of the pragmatic literature review was set between 1st of January of 2000 to 31 of May of 2020. The reason to start the revision from 2000 is that the explosion of fitness franchises and the increasing of people exercising in fitness centres has mainly occurred within the two decades of the XXI Century despite the new concepts of fitness centres started few years before [1]. In fact, the barrier of 100,000 fitness clubs worldwide was not surpassed until 2008 whist it was doubled in 2016 [2]. The search was conducted in the databases of Google Scholar, MedLine and PubMed, but references of relevant papers were also screened. The App7-Table 1 shows the keywords used for this search.

App7-Table 1. Keywords used to conduct the pragmatic literature review

Concept	Search items
Filters	From 1st of January of 2000 to 31 of May of 2020; English spelling; Adults (≥ 18 years old)
Places	Community centre; Fitness centre; Gym; Leisure centre; Health club; Sports club
Population	Non-clinical adults; Healthy adults
Keywords	Adoption, Adherence; Attendance, Barriers; Behaviour; Behaviour change; Behaviour Change Technique; BCT; Behaviour change strategy; Behaviour intervention; Behaviour modification; Dropout; Drop-out; Exercise; Exercise behaviour; Exercise intervention; Facilitator; Fitness; Health behaviour; Intervention; Intervention behaviour; Lifestyle; Lifestyle change; Lifestyle intervention; Lifestyle modification; MVPA; Physical activity; Physical activity behaviour; Physical activity intervention; Physical inactivity; Physical inactivity intervention; Retention; Sedentariness; Sedentarism; Sedentary behaviour

All the terms were searched either in British English or American English (e.g. fitness centre/fitness center)

Due to the searching scope was very wide, a total of 43,325 papers were selected in the first screening process. From these papers, a total of 2,868 were identified as potential papers only using the title (Revision Round 1). Afterwards, a second screening process was performed in order to select the final list of potential papers (Revision Round 2). In this second screening process, the abstract was reviewed. However, a full reading was done if further information was required to select or reject the paper. Moreover, the reference list of the manuscript was also screened to identify additional potential papers. In total 214 papers were selected in the Revision Round 2. For the Revision Round 3, all the potential papers were listed in a random order. This list was followed to conduct the pragmatic literature review until saturation. In this study, saturation was considered when the information from ten papers screened in a row did not provide relevant information to design a new potential item for the questionnaire. However, to reduce the risk of bias, a minimum of reviewing 50% of the potential papers screened papers was set. In total, 170 papers were screened (79%), but only 48 were used in the pragmatic literature review. App7-*Table 2* shows the research papers used in the pragmatic literature review excluding the review papers which are displayed in the App7-*Table 3.*

App7-Table 2. The research papers used in the pragmatic literature review excluding the review papers.

Authors	Study design	Sample characteristics	Groups characteristics	Main objective
Annesi [3]	Three research works (RTC)	1762 non-clinical adults	Randomised groups	To test the present cognitive behavioral treatment protocol with new and returning adult exercisers, within fitness center settings in the United States, United Kingdom, and Italy
Arikawa et al. [4]	RCT	164 premenopausal inactive women	Randomised groups	To provide an analysis of demographic factors contributing to women's adherence to a 2-year twice-weekly weight training intervention
Blais et al. [5]	Quasi-experimental	88 non-clinical adults	Non-randomised groups	To examine the effectiveness of a 12-week weight loss intervention within a commercial fitness centre on body weight, moderate to vigorous physical activity (MVPA), dietary intake, and behavioural regulations for exercise and healthy eating.
Brown et al. [6]	Qualitative research	657 non-clinical adults	Not applicable	To compare current, former, and non-members' perceptions of the motivational climate of a university campus fitness facility
Caudwell and Keatley [7]	Cross sectional	100 non-clinical males' adults	Not applicable	To investigate the influence of men's body attitudes alongside implicit and explicit motivation on gym attendance.
Coen [8]	Qualitative research	52 non-clinical adults	Not applicable	To advance a more critical geography of physical activity that contends with the micro-level socio spatial processes implicated in gendering physical activity participation and thus, health.
Crespin et al. [9]	Quasi experimental	2972 non-clinical adults	Non-randomised	To examine the effect of participation in an incentive-based wellness program on self-reported exercise.
DellaVigna and Malmendier [10]	Cross sectional	7978 non-clinical adults	Not applicable	To analyse a novel data set from three US health clubs with information on both the contractual choice and the day-to-day attendance decisions over three years
Fisher et al. [11]	Qualitative research	8 non-clinical women (20-30 years + one of 64 years)	Not applicable	To illuminate women's gendered experience within a traditional, mixed gendered gym
Foroughi et al. [12]	Cross sectional	379 non-clinical adults	Not applicable	To investigate the effects of process and outcome quality on fitness members' delight and satisfaction
Gazmararian et al. [13]	RCT	410 non-clinical adults	Randomised groups	To evaluate the effectiveness of addressing multiple barriers to physical activity (PA) using interventions at the workplace
García-Fernández, et al. [14]	Quasi-experimental	1805 non-clinical adults	Non-randomised groups	To analyse the relationship between quality, value, satisfaction and the future intentions of clients of public and private low-cost fitness centres and their difference
Gonçalves et al. [15]	Cross sectional	146 non-clinical adults	Not applicable	To understand how attributes perception, expectations, well-being and satisfaction influence membership retention in fitness clubs
Jasinskas et al. [16]	Quasi-experimental	433 non-clinical adults	Not applicable	To evaluate the quality of services in fitness centres in Kaunas
Kaushal and Rhodes [17]	Cross sectional	111 non-clinical adults	Not applicable	To investigate the behavioural requirements for exercise habit formation
Kaushal et al. [18]	RCT	94 non-clinical adults)	Randomised groups	To test if changes in habit, as well as other behavioural strategy constructs from the Multi-Process Action Control Test, mediated between group condition and MVPA (self-report and accelerometery)
Kaushal et al. [19]	RCT	94 non-clinical adults	Randomised groups	To examine the impact of a habit formation intervention on PA over 8 weeks in a two-arm parallel design, randomized controlled trial
Lagrosen and Lagrosen [20]	Qualitative research	55 staff members and 71 non-clinical adults	Not applicable	discover quality dimensions for the health-and-fitness industry and to examine the salient aspects of the quality-management practices of organisations in this industry
MacIntosh and Law [21]	Qualitative research	26 non-clinical adults	Not applicable	To identify and compare the reasons why people join, maintain, and cancel their fitness membership through the lens of the TPB, while incorporating concepts from service quality and organisational culture

				research.
Mazzuca et al. [22]	Quasi-experimental	101 clinical adults	Randomised intervention groups (no control group)	To define the relative effectiveness of the supervised physical activity program vs. a cognitive-behavioural intervention promoting self-selected physical activity in subjects with obesity or type 2 diabetes
Middelkamp, et al. [23]	Cross sectional	259,355 non-clinical adults	Not applicable	To apply the TTM's stages of change to examine patterns of attendance behavior at fitness clubs
Middelkamp, et al. [24]	Experimental research	122 non-clinical adults	Randomised groups	To test the effects on exercise behaviour over 52 weeks and the long-term relationships of all TTM constructs
Miller and Miller [25]	Cross sectional	1552 clinical adults	Non-randomised groups	To compare attitudes of overweight (OW) and normal weight (NW) adults regarding health club exercise.
Nuviala et al. [26]	Cross sectional	642 non-clinical adults	Not applicable	To identify the reasons for attrition given by customers who quit their memberships at sports centres, and whether reasons are related to duration of membership
Nuviala et al. [27]	Cross sectional	547 non-clinical adults	Not applicable	To design, to validate and to verify the reliability of a useful instrument as way of evaluation of the motives of the dropout of the organized PA that provide the different sport centres.
Oh et al. [28]	Cross sectional	254 non-clinical adults	Not applicable	To establish a theoretical basis for evaluating a strategic increase in customers' perceptions of service quality (technical quality and functional quality) and relationship benefits—specifically in terms of an increase in relationship commitment and customer loyalty in membership fitness club and to test this theoretical basis empirically.
Pridgeon and Grogan [29]	Qualitative research	14 non-clinical adults	Not applicable	To investigate experiences of maintaining and dropping out of a gym-based exercise programme
Clavel et al. [30]	Cross sectional	1977 non-clinical adults	Not applicable	To create a model for predicting dropouts at a sport centre based solely on actual customer behaviour
Clavel et al. [31]	Cross sectional	non-clinical adults	Not applicable	To investigate the behaviour of leisure centres' users for a year to analyse the plausible difference in behaviour between users dropping out and those who do not. In addition, it is also intended to identify the behavioural variables to establish the probability of dropping out from a leisure centre
Teychenne et al. [32]	RCT	318 clinical middle aged and older women	Randomised groups	To compare the effectiveness of a standard ST program (SST) to an enhanced program (EST) on the adoption and maintenance of ST and cardio-metabolic risk factors and muscle strength.
Theodorakis et al., [33]	Cross sectional	332 non-clinical adults	Not applicable	To analyse three competing models to clarify the relative role of antecedents to behavioural intentions in sport and fitness centres
Tsitskari et al. [34]	Cross sectional	378 non-clinical adults	Not applicable	To segment fitness centers' members through their exercise motives and further profile them according to their perceptions of service quality and loyalty
Verhoef et al. [35]	Quasy-exprimental	1025 non-clinical adults	Non-randomised groups	To study the cost-effectiveness (in terms of the incremental cost per quality-adjusted life-year (QALY) gained) of the third (most recent) incarnation of the Give it a Go scheme
Yi et al., [36]	Cross sectional	2,385 members of fitness centres	Not applicable	To analyse the relationship between customer visit frequency and retention in the fitness industry
Zarotis and Arvantidou [37]	Qualitative research	225 non-clinical adults	Not applicable	To study if various reasons for quitting activity in a gym are age-dependent
Zarotis et al. [38]	Qualitative research	225 non-clinical adults	Not applicable	To study how strong are the various reasons for abandoning activities in a fitness studio

App7-Table 3. The review papers used in the pragmatic literature review

Authors	Revision type	Main objective	Population
Avery et al. [39]	Systematic review	To explore which behaviour change techniques and other intervention features are associated with increased levels of physical activity and improved HbA1c in adults with Type 2 diabetes.	Adults with Type 2 diabetes
Ashford et al. [40]	Systematic review and meta-analysis	To fill the gap of self-efficacy in physical activity interventions by systematically gathering intervention studies which aimed to increase self-efficacy for physical activity	Non-clinical adults
Bishop, et al. [41]	Systematic review	To describe and explore the effects of contextual and behaviour change technique (BCT) content of control and target interventions in clinical trials	Clinical adults
Cradock et al. [42]	Systematic review and meta-analysis	To identify the Behaviour Change Technique and intervention features of dietary and physical activity interventions that are associated with changes in HbA_{1c} and body weight	Adults type 2 diabetes
French et al. [43]	Systematic review	To identify behaviour change techniques (BCTs) that increase self-efficacy and physical activity behaviour in non-clinical community-dwelling adults 60 years or over.	Older adults
Muller-Riemenschneider, et al. [44]	Systematic review	to evaluate the long-term effectiveness of physical activity interventions targeted at healthy adults and to identify effective intervention components	Non-clinical adults
Murray et al. [45]	Systematic review and meta-analyses	To examine the effectiveness of PA interventions for behaviour change maintenance in young and middle-aged adults, and investigated which Behaviour Change Techniques (BCTs) and other intervention features were associated with maintenance	Young and middle aged non-clinical adults
Rhodes and Pfaeffli [46]	Literature review	to update the understanding of determinants of Physical activity that include proposed mediators of behaviour change	Non-clinical adults
Samdal et al. [47]	Systematic review and meta-regression analyses	to explain the heterogeneity in results of interventions to promote physical activity and healthy eating for overweight and obese adults, by exploring the differential effects of behaviour change techniques (BCTs) and other intervention characteristics.	Overweight and obese adults
Williams and French [48]	Systematic review	To estimate the association between specific intervention techniques used in physical activity interventions and change obtained in both self-efficacy and physical activity behaviour	Non-clinical adults

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Appendix 8. Transcription face to face interview with fitness centres instructors

Participant	Responses
Participant 1.	To be honest. I would not like to be part of this intervention. I think I have enough work to do, and I have no time to spend with just a customer. If I had to be part of this, the company should redefine my job conditions. If you check the ratio of staff/members, you will realise that there is no way I can spend 10-15 minutes with just one customer. I guess this intervention might work, but it requires us to support participants, and it means follow-up them, assisting them when exercising, etc. This is not that simple. At present, I must check everything is organised and ready to be used, place the weight and dumbbell, attend to people, etc. When do I assist the customer? It is just impossible. I just cannot be in charge of delivering the so-called BCTs. On the other hand, the gym needs to define how we should do the follow-up. We have only one computer in the fitness room to assign training to our members. I guess we will need a tablet o something to do it.
Participant 2	I think the proposal is cool. It would increase the importance of fitness centres workers. However, I wonder if being part of this intervention would mean more work to do and a similar income. Would the company increase our income? I think the company should increase our salary if we take part in this kind of intervention as we would provide higher value to customers. Also, improve our working conditions as many of us are part-time and need two jobs. Regarding the intervention, I would like to be part of it. I think we all want to support people to be more active. This is what we studied for, right? I think many people would benefit from this. One of the problems I see for me to be part of the intervention is that the staff might need to have a private space to assist the customer. We have a space to assist customers, but we cannot use it for 5-15 minutes while someone else is waiting. On the other hand, I think the staff would need quite a lot of training. I am not that sure if I would be able to provide the "BCTs" right on my own. Some of them are not that easy to understand and I do not know if I have the skills to do so.
Participant 3	I like your intervention, but, not sure about the implications for my job. Would it require higher control from the company? If it means the company is going to control my performance and evaluate how efficient I am working more deeply, I do not want to take part. Also, for me, one of the problems is that in my company staff are doing training courses every 15 days, and this requires additional training. I just do not want to spend more time in training. As I said, the intervention is fine, but now thinking, I need the training to be part of it. For instance, why should I provide one BCT or another? I think we can do more things than those you identify in your proposal. Can I decide what BCTs deliver to each person? On the other hand, I am not sure of the resources for applying this intervention. However, I think we should get a laptop or tablet to follow up with customers. Otherwise, how can we follow up with people? Also, in technological gyms, it might work, but mine has no technology to track people, only the access point. Another problem I see is the low ratio of staff/customers. I see positive aspects though. I think it is nice project. Being part of this intervention would increase my value. But as I said, what you showed me is quite complex. It might also improve my working conditions, but just in case I would rather not be selected for doing this kind of job, at least in the first group. I like what I do now and do not want it to change.
Participant 4	Yes, I think I would like to be part of this intervention. I agree fitness centres need to increase retention and I think this kind of initiative might positively contribute to it. I think I understand what you want from us (fitness instructors) in this intervention. However, I would need you to teach us how to deliver what you call BCTs. I think some of them are quite easy and we even do something similar to what you propose. However, some others are more complex. For instance, what should I do with a person who commits to exercise 2-3 days a week but just never show up? Also, how should I ask a person to commit? It might be some members might not like some BCTs. Besides this, I think my centre can implement this intervention. It is quite big and recently adopted new technology to track and contact customers. However, I admit that not all fitness centres might have the resources

	to implement the intervention. I.e., you need a specialised staff and a place they can engage the customer for a few minutes. Also, we have many tablets and a very nice system to follow up with customers, but it is not the case with my previous centre. As I said, I would like to be part of this intervention. It is an additional responsibility, but if it works, it will increase my value as a fitness instructor, and I think it can improve my job conditions.
Participant 5	I would like to be part of the intervention. I guess it will require an extra effort, but if this engages more people in physical activity, it would be worth it. My point is; however, would the company incentivise us for taking this additional job? Let me explain myself well. I am happy in with my work, I like what I do, I master my job, and I love the environment is really good. But I think this initiative makes sense. The problem is that I think being part of this intervention exceeds my initial obligations and requires extra training. I think the company should incentivise us for adopting a significant role in the intervention development. I think I have already quite a lot of work to do. Being part of the intervention is not that easy, and some of my fears are my job conditions to worsen. Nonetheless, I maintain my willingness of being part of the intervention even though it seems quite complex, and I would need to study quite a lot. I also appreciate you are doing this intervention. However, for me, the main barrier is the schedule. It changes every week, and we are already full of jobs, so I would need it to be better to be able to deliver the intervention. I would need time to engage the customer, follow up and supervise him/her.
Participant 6	To be fair, I do not think this intervention will work. I think people will have the same behaviour. They start motivated, but they soon leave it. It just won't work. Moreover, I like my job as it is now. Not too much interaction with people. Besides, if this intervention is implemented, the responsibility to retain customers would go to fitness instructors. I do not want to have this extra responsibility. We already have a lot of stuff to do, e.g., music management, dealing with many different types of customers, etc. No thank you. Also, do you know why I do not want to be part? Because I just cannot. In this field, many people have two jobs as many of us are part-time or the income is quite low. I am not going to leave one job if I am not sure the other job will maintain my full-time conditions. If I have to be part of the intervention, I need time to follow up with customers, additional training, bla bla bla. Moreover, what if I am not good at doing this work, or maybe it just does not work. what would happen to me?
Participant 7.	I think the current model is ok. I would add this as an extra, but with professionals who know about this stuff. I do not study behaviour change. What if I make it wrong? On the other hand, I do not understand what you call BCTs, why should I use only these BCTs? And how is it supposed I should deliver them? No, it is quite complex for me, and I would rather not take part in the intervention. I like what I do now, and I do not want it to change and bring worst job conditions. Also, I am already doing a lot of stuff in the gym, I am happy with how I am now. To be part of this intervention, I would need the company to redefine the gym. Where is it supposed I must engage the customer? I also need a tablet or something for the follow-up. We have a place for customers, but we share this space among three workers and the current guidelines force us to finish in 3-5 minutes. Well, as I said, being part of the intervention is complex. I would need to study if it made sense or my benefits to be part of the intervention, but so far, I think I would not like to be part of it.