Exercise Adherence for Wellbeing: Barriers, Practices and Strategies

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Brain Capital Alliance

Brain Economy Hub

ABOUT THIS WHITE PAPER

This White Paper is the outcome of a working group coordinated by EMEA in 2024. The working group had several online meetings to discuss the different sections of the paper.

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1 INTRODUCTION

Exercise adherence, or the sustained commitment to a regular physical activity routine, is crucial for enhancing both mental health and overall well-being. In today's fast-paced world, sedentary lifestyles have become a global public health challenge, with profound implications for individuals and communities.

A sedentary lifestyle is a global phenomenon that affects more than half of the population. Studies carried out in various countries and regions of the world confirm that most adults spend between 55% and 60% of their time on sedentary behaviors. As for young people, according to the World Health Organization (WHO), 81% of adolescents do not meet the recommended levels of physical activity. Likewise, the WHO assures that sedentary lifestyles contribute to approximately 5.3 million deaths globally each year (WHO, 2022a). These percentages are significantly higher in the Americas and the Eastern Mediterranean Region.

Alarmingly, trends are moving in the wrong direction: a new World Obesity Atlas report (WOF, 2023) predicts that by 2035, 51% of the global population—over 4 billion people—will be living with overweight or obesity, if current trends continue. According to WHO, almost 500 million people will develop heart disease, obesity, diabetes, or other noncommunicable diseases (NCDs), which are attributable to physical inactivity, between 2020 and 2030, costing US$ 27 billion annually.

Additionally, in 2019, approximately one in eight people worldwide were living with mental disorders, a situation that had worsened significantly since the COVID-19 pandemic (WHO, 2022b) [1].

WHO highlights that regular physical activity can reduce the risk of chronic diseases, improve cardiovascular health and enhance mental well-being (WHO, 2022c). Regarding the impact on mental well-being, extensive scientific literature underscores exercise as a powerful agent for improving mood, by alleviating symptoms of anxiety and depression, cognitive function and resilience against stress. As detailed in the following pages, exercise acts as a natural antidepressant by stimulating the release of endorphins and neurotrophic factors. It

[1] Amount of Time Spent in Sedentary Behaviors in the United States, 2003–2004 - PMC (nih.gov); Association of sedentary behaviour with metabolic syndrome: a meta-analysis - PubMed (nih.gov); Physical activity and sedentary behavior patterns and sociodemographic correlates in 116,982 adults from six South American countries: the South American physical activity and sedentary behavior network (SAPASEN) | International Journal of Behavioral Nutrition and Physical Activity | Full Text (biomedcentral.com); Prevalence and patterns of physical activity, sedentary behavior and their association with health-related quality of life within a multi-ethnic Asian population | BMC Public Health | Full Text (biomedcentral.com); The prevalence of sedentary behavior amongst university students in Saudi Arabia | BMC Public Health | Full Text (biomedcentral.com)

also enhances cognitive abilities by promoting neurogenesis and synaptic plasticity in key brain regions.

Despite these well-documented benefits, exercise adherence remains a significant challenge, with many individuals struggling to initiate and maintain consistent exercise habits.

This paper aims to provide further insights into the link between exercise, well-being and mental health, to analyze the current barriers to exercise adherence and to inspire with selected case studies. It also proposes strategies and measures to improve exercise adherence and key recommendations to inform and inspire ecosystem enablers — policymakers, development institutions, public and private health initiatives and community leaders — to foster environments which prioritize mental health and well-being through sustained physical exercise and activity.

2 EXERCISE ADHERENCE AND WELL-BEING

Well-being, including mental health, is crucial for individuals and societies because they determine our ability to handle stress, perform daily activities and enjoy life.

Box1: Concept Definitions

Well-being

Well-being refers to a holistic experience of health, happiness and prosperity. It is a comprehensive state of satisfaction and balance in a person's life, which encompasses physical, mental and emotional health. According to the WHO, it is a state in which individuals can manage moments of stress, develop their full capabilities, work productively and contribute to their community (World Health Organization, 2022) (Comunidad de Madrid, n.d.).

Mental health

According to the WHO, mental health is defined as a state of mental well-being that enables people to cope with the stressors of life, realize their abilities, learn well and work well, and contribute to their community. It is an integral component of health and well-being that underpins our individual and collective abilities to make decisions, build relationships and shape the world we live in. Mental health is a basic human right. And it is crucial to personal, community and socio-economic development. (World Health Organization, 2022) (de Pedro-Cuesta et al., 2016).

It includes the absence of mental disorders and the development of skills to face daily challenges. It is essential for the general well-being and quality of life of individuals (Cámara Oficial de Comercio, Industria y Servicios de Madrid, n.d.).

Public health

The WHO refers to Public Health as “all organized measures (whether public or private) to prevent disease, promote health, and prolong life amongst the population. Its activities aim to provide conditions in which people can be healthy and focus on entire populations, not on individual patients or diseases”. Therefore, public health is responsible for protecting and improving the well-being and mental health of populations through the prevention of diseases, the promotion of healthy lifestyles and health surveillance. It focuses on primary prevention and interventions that improve collective well-being, using an approach that includes both physical and mental factors to promote optimal health in the population (Ballester-Martínez, Baños, & Navarro-Mateu, 2022).

Exercise adherence refers to a person's ability to maintain regular physical activity routines consistently over time. This not only involves starting an exercise program, but also continuing with it long term, overcoming barriers such as lack of motivation, time and physical limitations (Vella et al., 2023). It is crucial for well-being, mental health and public health for several reasons (Salman et al., 2019):

Well-being: Regular exercise improves quality of life by increasing energy levels, promoting restful sleep and reducing stress and anxiety. This leads to more positive physical and emotional well-being, improving self-esteem and personal satisfaction (Alexandratos, Barnett, & Thomas, 2012) (UNED, n.d.).

Mental health: There is strong evidence that exercise has positive effects on mental health, reducing depression, anxiety and improving overall mood. These benefits are due to both the biological effects of exercise on the brain and the psychological aspects of achievement and self-discipline that it promotes (Granero-Jiménez et al., 2022) (Martínez et al., 2022).

Public health: Adherence to exercise contributes to the prevention of chronic diseases such as diabetes, heart disease and obesity, thus reducing the burden on public health systems and improving the quality of life of the general population (Rivera-Torres, Fahey, & Rivera, 2019).

Regular exercise has been widely studied for its benefits for both physical and mental health.

Physical Health: Research has shown that regular exercise helps maintain a healthy body weight, strengthens the cardiovascular system, improves lung function, reducing the risk of chronic diseases such as type 2 diabetes, as well as cardiovascular diseases or hypertension (NHS, n.d.) (World Health Organization, 2024).

The cardiovascular effects are not limited to strengthening the heart. They also improve blood circulation, in addition to helping to reduce LDL cholesterol levels and increase HDL cholesterol levels. They also favorably impact bone and muscle health, preventing the loss of bone and muscle mass that occurs during ageing (frailty and sarcopenia) and increasing flexibility and balance, thus reducing the risk of falls and injuries (Zhang & Jiang, 2023). Studies have also shown that physical activity reduces the risk of some types of cancer.

In older adults, regular exercise helps maintain muscle and joint function, promotes functional independence and reduces the risk of falls and bone fractures. This contributes to a better quality of life, by making it easier to carry out daily and social activities.

Mental health: In terms of mental health, regular exercise is a powerful anti-stressor, anxiolytic and antidepressant, with numerous studies in which it has more direct impact than some pharmacological interventions. From the viewpoint of neurobiology, many of the

cellular, molecular, genetic and epigenetic mechanisms that mediate these effects are also known, thus becoming potential and promising pharmacomimetic therapeutic agents.

In this sense, physical activity releases endorphins (natural painkillers that elevate mood) and growth factors, both inside the brain and some outside the brain, which enter its interior through the blood-brain barrier and exert numerous actions on nervous tissue (Chekroud et al., 2018). It also improves the quality of sleep, which is crucial for memory consolidation (Better Health Channel, n.d.) (Wu et al., 2023) (NHS, n.d.) (Zhang & Jiang, 2023) (World Health Organization, 2024).

Exercise has precognitive effects, increasing the cognitive ability to learn and memories information, both spatial and non-spatial, as well as attention and information processing, which can be especially beneficial for ageing people.

Psychological aspects: Studies highlight that regular exercise not only improves physical and mental health, but also strengthens psychological well-being, by increasing self-esteem, improving mood and promoting a greater sense of control and self-efficacy. Also, physical activities are a good way to socialize, reducing feelings of loneliness and isolation (Mahindru, Patil, & Agrawal, 2023) (Cammisuli et al., 2023) (World Health Organization, 2024).

In recent decades, basic translational neurobiological research has generated outstanding scientific evidence on the effects of physical exercise on the brain, highlighting its role as an antidepressant, anxiolytic and procognitive. These effects take place through direct structural and functional changes in the brain, particularly in areas related to mood regulation, anxiety and cognition. And strikingly, in the hippocampus.

Mood improvement

Regular exercise is associated with significant improvements in mood, including a reduction in depressive symptoms and a greater sense of emotional well-being (Lynette & Perna, 2004) (Mayo Clinic Staff, 2023) (Better Health Channel, n.d.).

Physical exercise has been found to increase neurogenesis in the hippocampus, a brain region crucial for memory and mood regulation. This effect is mediated by increasing the amount of growth factors, such as BDNF (Brain-Derived Neurotrophic Factor), which supports the survival of existing neurons and encourages the growth of new ones; IGF1 (Insulin-like Growth Factor 1), which promotes cell growth and development; and VEGF (Vascular Endothelial Growth Factor), which stimulates the formation of new blood vessels, enhancing the brain's blood supply.

These factors initiate a cascade of actions that increase the survival of neurons, including those present from birth and those generated in adulthood (adult hippocampal

neurogenesis). They also promote neuronal differentiation and synaptic plasticity across all brain regions. Collectively, these changes result in improvements in cognitive function and mood. Additionally, exercise regulates the hypothalamic-pituitary-adrenal (HPA) axis, decreasing levels of cortisol, the stress hormone.

Anxiety reduction

Studies have shown that physical activity can reduce anxiety levels and improve the ability to manage stress (Lynette & Perna, 2004) (Singh et al., 2017) (Better Health Channel, n.d.).

As an anxiolytic, exercise acts on the amygdala, the brain region involved in the response to fear and anxiety. Exercise modulates the activity of serotonin and norepinephrine, neurotransmitters involved in the regulation of anxiety. Regular physical activity increases the levels of both neurotransmitters in the brain, improving mood and reducing the perception of anxiety. In that sense, studies have revealed that the anxiolytic effect of exercise may be more effective in reducing anxiety levels than some anxiolytic medications.

Cognitive improvement

According to scientific evidence, exercise improves various cognitive functions, amongst which memory, attention and processing speed have been reported, thereby benefitting long-term cognitive health (Lynette & Perna, 2004) (Singh et al., 2022).

These effects are again related to the increase in the levels of trophic factors, as well as the improvement in cerebral vasculature and blood flow, synaptic plasticity, the formation of new synapses, as well as the formation of new neurons, facilitating learning and memory. Functional magnetic resonance imaging has revealed that regular exercise is associated with an increased volume of the hippocampus and other brain regions related to memory and cognition.

These benefits are attributed to several mechanisms, including the release of endorphins and neurotransmitters, such as serotonin and brain-derived neurotrophic factor (BDNF), which promote neuroplasticity and protect against oxidative stress in the brain (Lynette & Perna, 2004) (Ren & Xiao, 2024) (Better Health Channel, n.d.).

3 STATUS QUO & ADDRESSING THE BARRIERS TO EXERCISE ADHERENCE

Research into the lack of commitment to physical exercise protocols detects that there are two fundamental types of concerns in relation to that challenge: those who begin a routine being previously sedentary; and those who are not sedentary but have to maintain or progress in their exercise routine (Bethancourt et al., 2019) (Schutzer & Graves, 2020) (Mikolaizak et al., 2022). Understanding and addressing the distinct issues faced by these groups is critical to promoting long-term health and well-being.

Fundamentally, there are two not directly related problems: barriers and lack of adherence, which are not the same type of problem at all. Based on existing research, the authors of this white paper consider "barrier" to physical exercise routines as being any obstacle or impediment, whether physical, psychological, social or environmental, which hinders the beginning or maintenance of physical activity (Bethancourt et al., 2019) (Schutzer & Graves, 2020) (Graham, 2021). On the other hand, "lack of adherence" is defined as the inability to consistently follow an established exercise routine, despite having begun one (Graham, 2021) (Mikolaizak et al., 2022).

Barriers to exercise initiation and maintenance

For those who seek to start exercising, the most common barriers include:

- **Lack of motivation:** Many older adults do not feel the urgent need to start exercising, due to lack of intrinsic motivation (Schutzer & Graves, 2020) (Mikolaizak et al., 2022).
- **Fear of injuries:** There is a prevalent fear of injuries during physical activity, which discourages many from starting the activity (Schutzer & Graves, 2020) (Mikolaizak et al., 2022).
- **Pre-existing health problems:** Chronic conditions are an important concern, which can prevent older adults from starting to exercise (Schutzer & Graves, 2020) (Graham, 2021).
- **Lack of knowledge:** The lack of information on how to start an adequate and safe exercise routine is a significant obstacle (Schutzer & Graves, 2020) (Bethancourt et al., 2019).

On the other hand, for those who have already begun to exercise and seek to maintain their routine, barriers include:

- **Lack of time**: Personal and family responsibilities can interfere with the ability to maintain a constant exercise routine (Bethancourt et al., 2019) (Schutzer & Graves, 2020) (Gao et al., 2024).

- **Low motivation:** Although motivation can be high at the beginning, maintaining it over time is a common challenge (Bethancourt et al., 2019) (Schutzer & Graves, 2020) (Graham, 2021).
- **Environment and climate:** Adverse climatic conditions and lack of adequate facilities can hinder the continuity of the exercise (Bethancourt et al., 2019) (Sirotiak et al., 2024).
- **Physical pain and discomfort:** Even if they are not serious, physical discomfort can demotivate older adults to continue their exercise routine (Schutzer & Graves, 2020) (Graham, 2021).

As referred to in Chapter 2 of this white paper, the World Health Organization's "Global Recommendations on Physical Activity for Health" indicates that adherence to physical exercise protocols can significantly improve cardiovascular health, mental health and reduce the risk of diseases, such as type 2 diabetes, certain types of cancer and obesity. Additionally, commitment to exercise routines, such as regular walking, can improve muscle strength, flexibility and quality of life (Morris & Hardman, 2021) (World Health Organization, 2022) (World Health Organization, 2018) (World Health Organization, n.d.).

However, the WHO acknowledges that there are multiple barriers affecting adherence to these protocols, including individual, social and environmental factors. Amongst these individual factors are lack of motivation, fear of injuries and the perception of lack of time. Social barriers include the lack of support from family and friends, whilst environmental barriers can include a lack of adequate facilities (World Health Organization, 2022) (World Health Organization, 2018) (World Health Organization, n.d.).

Surprisingly, it is not easy to find any specific WHO recommendations about increasing adherence to physical exercise routines for any specific sector of the world's population. It is true that the WHO recommends several strategies to address the problems surrounding the lack of adherence to physical exercise routines.

These strategies include interventions at the individual, community and public policy levels (World Health Organization, 2022) (World Health Organization, 2018) (World Health Organization, n.d.):

- Education and Consciousness.
- Community-based interventions.
- Social support.
- Program adaptation.

- Public policies and physical environments.
- Monitoring and evaluation.

Key factors on adherence to physical exercise

Addressing barriers to exercise adherence requires consideration of three key aspects: social and environmental factors, work-related barriers, and behavioral perspectives:

Several authors argue that WHO recommendations do not always consider the social and environmental factors that influence adherence to exercise, particularly amongst older adults (Bethancourt et al., 2019) (Rivera et al., 2024) (Schutzer & Graves, 2020).

A good number of other authors underline the need for more personalized interventions based on behavior change techniques, which can integrate into the daily life of the elderly (Mikolaizak et al., 2022) (Watson et al., 2024).

The literature review has shown that there is insufficient coverage of work-related barriers to exercise (Gao et al., 2024). The main barriers to exercise in relation to the work environment are intrinsic and extrinsic. Intrinsically, the barriers are due to the need - widely encouraged in the workplace - to remain at the workplace continuously, which is very relevant since a huge proportion of jobs in today's world are carried out sitting in front of a computer (Scheller & Bachner, 2024) (Gao et al., 2024).

Extrinsically, the need to work a large number of hours (and overtime in many cases) takes away both time and the energy to exercise, once the workday ends or before it begins (Scheller & Bachner, 2024) (Gao et al., 2024).

Traditional approaches to exercise adherence often overlook the importance of incorporating a behavioral perspective, which can address the psychological and human aspects that are critical to maintaining long-term engagement. The study by Watson et al. (2024) highlights the significance of aligning knowledge, motivation and resources through behavioral strategies to improve exercise adherence (Watson et al., 2024).

Ignoring these psychological factors not only poses a barrier but also presents an opportunity to enhance adherence through targeted interventions (Watson et al., 2024).

Integrating these behavioral insights as a transversal tool can bridge gaps in current methodologies, providing a more holistic approach to supporting individuals in their exercise routines and ultimately leading to better health outcomes (Watson et al., 2024).

Addressing adherence improvement

Barriers to adherence should be addressed pre-intervention, to enhance intervention efficacy (Bethancourt et al., 2019) (Rivera et al., 2024) (Schutzer & Graves, 2020) (Gao et al., 2024)

There is no comprehensive methodology and protocolization to address either the lack of adherence to physical exercise routines or the barriers to implementing physical exercise protocols (Mikolaizak et al., 2022).

It could be beneficial to address these different barriers collectively rather than in isolation. Integrating social, environmental, work-related and behavioral factors can provide a more holistic approach to supporting individuals in their exercise routines (Sirotiak et al., 2024) (Watson et al., 2024). While this approach is theoretically supported, more research is needed to develop specific models and frameworks, to validate the synergistic effects of combined interventions and to understand the contextual variability across different populations. Addressing these gaps will enhance our ability to design effective, multifactorial interventions for exercise adherence (Watson et al., 2024).

In addition to that, precision exercise, as a cutting age approach leveraging on data-driven technology and personalized approaches to fitness, can significantly enhance exercise adherence, by addressing the referred-to-above barriers that people face in maintaining a consistent and effective workout routine (Liu et al., 2024). For further information on the specifics of precision exercise see *Box 2*, in the section on strategies and measures.

Adherence can also be improved by framing it as a brain skill. This approach can be innovative, especially when it leads to a proactive approach to adherence to physical exercise. Adherence can be integrated as a learned and cultivated skill, similar to any other cognitive skill by focusing on behavioral, cognitive and neuro- psychological strategies. For example, studies have shown that certain patterns in brain networks can predict adherence to mental training programs, suggesting a neuro-biological basis for adherence behavior. This underscores the potential for targeting brain functions to improve adherence (Saghayi et al., 2020).

Another aspect can be linked to nutrition and hydration, both key factors in the mental and physical predisposition for the practice of physical exercise and, hence, to its adherence. The practice of exercise must be accompanied by adequate nutrition, to ensure the essential nutrients for optimal muscle performance and recovery, especially under the increased metabolic demands and oxidative stress generated by physical activity.

The interactions and impact of various nutrients, together with physical exercise on mental health, is an emerging field of research. Amongst nutrients, hydration is one of the main factors that jointly impact mental health and muscle performance. Dehydration directly influences both endurance, fatigue and attention, reaction time and short-term memory (Begade et al., 2021) (Ding et al., 2024) (Dalle et al., 2020).

A personalized approach that integrates nutrition, hydration practices and exercise is key to optimizing mental and physical health. Therefore, it should be addressed when designing strategies to promote adherence to physical exercise. This approach should consider various factors such as gender, age, and individual metabolic demands. There is sufficient evidence to indicate that there is a disparity in both body composition and the prevalence of different mental illnesses between men and women and different age groups.

Table 1: Detailed Analysis of Exercise Adherence Factors

Category	Aspect	Description
Motivation	Initial Motivation	Lack of intrinsic motivation is a significant barrier for many people wanting to start an exercise routine. The perceived need to exercise may be low, due to a lack of urgency or interest in the long-term benefits of physical activity.
	Continued Motivation	Maintaining motivation over time is a common challenge. Whilst enthusiasm can be high at the beginning, sustaining that level of motivation is difficult, due to lack of visible progress, boredom, or demotivation.
	Overlook of behavioral perspective	Although there is an ongoing academic debate into whether the lack of adherence to exercise should be addressed by initially focusing on attitude or behavior, traditional approaches often overlook the behavioral aspects of sustained motivation. Whilst prioritizing attitude has proven effective for many individuals, it may not be the optimal approach for everyone. More research is needed at this point.
Knowledge	Knowledge	A lack of information on how to start and maintain an adequate and safe exercise routine is a significant obstacle. Many people do not know where to begin, or what type of exercise is appropriate for their needs and limitations.
	Fears	Fear of injuries is prevalent and discourages many from engaging in physical activity. This fear can be based on past experiences, lack of knowledge about safe techniques, or the perception that exercise is inherently dangerous.
	False Beliefs	False beliefs about exercise, such as the idea that extreme effort is required to see benefits, can prevent people from starting or continuing an exercise routine. These beliefs can stem from misinformation or negative past experiences.

Resources	Time and Money	Personal and family responsibilities, along with financial constraints, can interfere with the ability to maintain a consistent exercise routine. The perception that exercise requires a lot of time or money can be a significant barrier.
	Occupational Constraints	Insufficient coverage of work-related barriers to exercise exists. Intrinsic barriers include the frequent imposition to stay at the workplace continuously, especially for desk jobs. Extrinsic barriers involve long working hours and overtime, which reduce both time and motivation to exercise before or after work.
	Adequate Facilities (Environment and Climate)	Adverse climatic conditions and lack of adequate facilities can hinder the continuity of exercise. Accessibility to safe and well-equipped spaces is crucial for maintaining a regular exercise routine.
	Baseline Health	Pre-existing health issues and physical pain or discomfort can be significant demotivators. People with chronic conditions, or who experience pain during exercise, may find it challenging to maintain a regular routine.
	Social Support	Lack of support from family and friends can act as a significant social barrier. Social support is crucial for motivation and long-term adherence.

4 STRATEGIES TO IMPROVE EXERCISE ADHERENCE

This chapter outlines a comprehensive framework of strategies and measures designed to enhance adherence to physical exercise.

A multi-faceted approach is presented, targeting both individual behaviors and systemic policies to foster a culture of consistent physical activity. It highlights the role of behavioral strategies in individuals, technological advancements and policy interventions in creating environments that support and encourage regular physical exercise.

By addressing the needs of diverse populations through tailored programs in workplaces, schools and communities, and by ensuring access to necessary infrastructure and professional support, this chapter provides actionable insights for policymakers and civil society.

The goal is to embed physical activity into the fabric of daily life, reducing sedentary behavior and its associated health risks, and ultimately, improving public health outcomes across the population.

Table 2: Summary of Strategies

Behavioral Strategies	1. Setting SMART Goals (Specific, Measurable, Achievable, Realistic and Time-bound): - Specific: Setting clear and concrete goals (Agencia Nacional de Evaluación de la Calidad y Acreditación, n.d.). - Measurable: Quantifying goals, such as tracking distance and time. - Achievable: Setting realistic goals that are attainable with appropriate effort and tailored to the individual's lifestyle. - Relevant: Aligning goals with personal interests and key health aspects, with prior specific medical assessments (Martínez Lozano, 2011). - Time-bound: Setting targets, for example, "run 5 km in 8 weeks." 2. Self-control, motivation and efficacy: - Planning: Creating a regular exercise schedule. - Monitoring: Using tracking tools, like mobile apps (García-Allen, 2016). - Self-reward: Rewarding oneself after completing exercise sessions. 3. Social Support: - Community: Joining clubs or groups with similar interests. - Accountability: Having an exercise partner. 4. Enjoyment and Variety: - Pleasant Activities: Choosing fun and varied exercises. - Innovation: Introducing new activities or variations in the routine. 5. Education and Awareness: - Benefits of Exercise: Informing oneself about the physical and mental benefits. - Proper Techniques: Learning and performing safe and effective exercise techniques. - Simple and accessible: Designing activities that are simple and accessible in various spaces, with low costs of time and money. - Flexibility: Planning flexible activities and turning their execution into a daily game. 6. Integration of "snack exercises" in daily routines: - Snack exercises involve short, frequent bouts of physical activity integrated into daily routines. - Sessions typically last less than a minute and are repeated multiple times throughout the day. - Snack exercises can be easily incorporated into various settings, such as home, work, or school. - This approach makes it easier for individuals to engage in regular physical activity without disrupting their daily schedules. - The flexibility and convenience of snack exercises help reduce daily sedentary behavior.

Technological Solutions to Reinforce Behavioral Strategies	1. Fitness Applications: - Tracking apps to follow progress and diet (M. A., 2023). - Personalized training apps offering individualized workouts (Navarro, 2023). - Gaming apps to make exercises more fun and interactive (Redacción Sport Life, 2023). 2. Wearable Devices (Brickwood et al., 2019): - Smartwatches and fitness trackers: Devices to monitor heart rate, calories burned, and sleep stages are useful for adjusting workouts and maintaining motivation (FasterCapital, 2024) (Cibanal, 2023). - Advanced Activity Monitors: Devices for advanced biometric data monitoring (FasterCapital, n.d.).
Policy-Driven Approaches	1. Development of a comprehensive National Strategy for physical exercise, movement and workplace performance in companies and public services: 1.1 Workplace Wellness Programs (Porath et al., 2024) (Murtagh et al., 2020) (Wu et al., 2021) (Shrestha et al., 2018): - Incentives: gym discounts, additional days off, rewards for achievements (Rehand, n.d.). - Flexible Schedules: Allow flexible hours to include exercise in daily routines. - On-site facilities: gyms or recreational areas at the workplace. - Education and Training Programs: programs on the benefits and techniques of exercise (Comunidad de Madrid, n.d.-a). - Integration of “Snack exercises” in the workday. 1.2 Integration of the fitness trainer profile, according to the mentioned National Strategy: - Incorporate a Physical Activity Support and Monitoring Department within the organizational structure of private companies, public services and public administration. - Define the necessary professional profiles for such a department. - Establish programs for continuous monitoring and improvement of company productivity and the physical and mental health of staff. - Design programs specifically tailored to different types of workplaces, such as office buildings, industrial facilities and telework spaces. 2. Promoting the Training of Professionals for physical exercise and integrating them into Public and Private Health Services: - Encourage physicians and other health professionals to prescribe physical exercise as part of treatments for various health conditions, providing guidelines and resources for patients to comply with these recommendations (Perez Córdoba, Contreras, & Campoy, 2022) - Consolidation of training programs for exercise professionals with a focus on health. - Integration of digital technology and AI knowledge into training programs. - Establishment of criteria for the professional equivalence of exercise professionals within the healthcare system.

	- Integration of exercise professionals into public and private healthcare systems, health insurance, etc. - Establishment of support programs for professional initiatives which encourage the use of public spaces and equipment for exercise and physical activity. 3. Public Health Campaigns: - Awareness campaigns using media, social networks, posters, etc., highlight the benefits of physical exercise and the risks of a sedentary lifestyle (Rehand, n.d.). - Community programs: free or low-cost fitness and physical activity classes (Comunidad de Madrid, n.d.-a). - Collaboration with local entities: partnering with local governments, schools and community organizations. - Exercise prescriptions by healthcare professionals: encouraging doctors and other health professionals to prescribe physical exercise as part of treatment and providing patients with guides and resources. - Establishment of collaboration protocols between doctors, fitness trainers and physical therapists to ensure a multidisciplinary approach to exercise prescription. - Implementation of a fast-track diagnosis and treatment system to reduce waiting times for conditions affecting daily activities, especially in the elderly, to minimize downtime and prevent functional decline due to inactivity. - Integration of movement "snacks" into the daily routine of the population. 4. Physical Education and Movement in Schools (Neil-Sztramko et al., 2021) (González-Calvo et al., 2018): - Mandatory physical education programs: fostering a culture of physical activity and movement from an early age. - Focus on learning and developing physical abilities (strength, endurance, speed and mobility). - Establish a daily hour of physical education. - Integration of snack exercises to interrupt sitting periods during school hours and working hours for all school employees 5. Economic Incentives: Subsidies and tax reductions to make gyms and sports centers more accessible to the population. Incentives for companies: tax benefits for companies offering exercise programs. Vouchers and discount programs: discounts on physical activities and sports equipment.
Community and Social Support Mechanisms	1. Support to communities for exercise and movement: - Support to local groups local training, physical activity and sports (10Mets, 2022).

	- Support free or low-cost community fitness classes in community centers, providing access to people from different socio-economic backgrounds (Rehand, n.d.) - Support the development of civil society movements that advocate a culture of movement and physical activity versus a sedentary environment. - Encourage support networks amongst friends and family and create "exercise buddies." - Support the organization of community events focused on exercise, physical activity and health (Coaching Camp, n.d.). 2. Volunteer Programs: - Mentorship: experienced volunteers who guide and motivate those new to exercise. - Participation of organizations: collaboration with neighborhood associations and NGOs (Belmonte Darraz et al., 2021). 3. Awareness Campaigns: - Promotion in local media to spread awareness about the importance of exercise and local opportunities, both professional and community-based. - Community education: workshops and seminars in schools, municipal facilities, workplaces, etc.
Infrastructure	1. Public and Accessible Gyms: - Outdoor Gyms: Install gyms in parks and recreational areas (Mobipark, n.d.). - Community Gyms: Provide low-cost gyms in urban and rural areas. 2. Access to Green and Healthy Spaces: - Parks and Trails: Provide spaces for walking, running and cycling (Mobipark, n.d.). - Creation of Multifunctional Recreational Areas: Develop green spaces with play areas and exercise zones (Lappset, n.d.). - Transform Existing Spaces: Convert existing infrastructure (ports, beaches, public promenades, parks, etc.) with appropriate equipment. 3. Publicly Available Sports Courts: - Multi-sport Courts: Provide courts for sports like basketball, soccer and volleyball (Serrano-Sánchez & Sanchís-Moysi, 2023). - Community Use Programs: Allow community access to courts and sports facilities during non-school or non-work hours.

Box 2: Precision Exercise

Precision Exercise refers to a highly individualized approach to physical activity, where exercise routines are carefully tailored to meet the specific needs, goals and physiological characteristics of an individual. This approach often involves detailed assessments and continuous monitoring, ensuring that each aspect of the exercise regimen is optimized for the person's unique body composition, fitness level, health status and personal objectives.

How It Differs from Regular Exercise

Individualization
Exercise plans are tailored, using personal data like genetics, metabolism, biomechanics and health status, to address unique characteristics and goals.

Data-Driven Optimization
Uses advanced technologies (e.g., wearables, genetic tests) for real-time feedback and continuous plan adjustments.

Goal-Specific Focus
Targets specific outcomes, such as athletic performance, chronic condition management, or body composition.

Preventative and Therapeutic Integration Applies exercise to prevent and manage health conditions, merging fitness with healthcare.

Benefits

Optimized Health Outcomes
Tailored to individual needs, this approach can more effectively prevent and manage health conditions, enhancing long-term health.

Increased Motivation and Adherence
Alignment with personal goals and quick, visible results make precision exercise more engaging, improving adherence rates.

Reduced Risk of Injury: Customized plans consider personal biomechanics and limitations, minimizing the risk of injury compared to generic routines.

Enhanced Performance: By focusing on specific areas for improvement, precision exercise enhances both athletic performance and daily functional capacity.

Holistic Wellbeing: Often combined with other personalized wellness strategies, such as nutrition and stress management, contributing to overall health.

Examples

Genetically Informed Programs; Metabolic Rate-Based Workouts; Biomechanically-Tailored Exercise; HRV Guided Training; Condition-Specific Plans; Wearable Technology Workouts; Rehabilitation-Targeted Exercises; Mind-Body Focused Programs; Sport-Specific Conditioning and Hormonal Balance Training

5 SELECTED CASE STUDIES

This chapter explores case studies that illustrate diverse strategies for promoting physical exercise, offering insights from countries around the world, namely: Sweden, Finland, China, Colombia, United States and South Africa.

In Sweden, the Physical Activity on Prescription (PAP) program integrates exercise into healthcare, showing how personalized prescriptions can effectively increase physical activity and improve public health outcomes.

Finland's "Schools on the Move" program exemplifies how incorporating physical activity into education fosters a culture of movement from an early age, benefitting both the health and academic performance of students.

China's national plans and strategies highlight the power of government policies to boost mass participation in physical activities, improving public access to fitness infrastructure and encouraging daily exercise.

In Colombia, Bogotá's "Gimnasios al Parque" program leverages urban planning to create accessible outdoor gyms, encouraging community-wide engagement in physical activity.

In North America, Johnson & Johnson's employee wellness programs demonstrate how workplace initiatives can successfully integrate regular exercise into daily routines, leading to improved health and reduced healthcare costs.

South Africa's Vitality program by Discovery employs economic incentives to motivate healthier lifestyles, reducing healthcare costs through rewards for physical activity.

Finally, the chapter explores the role of fitness apps and IoT gadgets in enhancing global exercise adherence through personalized tracking and community engagement.

These case studies collectively showcase the effectiveness of varied approaches—from policy initiatives to technological innovations—in promoting physical activity across the globe.

5.1 PHYSICAL ACTIVITY ON PRESCRIPTION (PAP) IN SWEDEN

Sweden's Physical Activity on Prescription (PAP) program, initiated nearly two decades ago, aims to combat low physical activity levels amongst adults. Highlighted by the WHO and OECD, this program has been adopted by nine other EU countries through a project co-funded by the European Commission (Andersen et al., 2018) (OECD, 2022).

The PAP program is structured around five essential components:

1. Customized counselling centered on the individual.
2. A formal written prescription.

3. Recommendations for physical activity based on scientific evidence.
4. Follow-up sessions.
5. A supportive environment facilitated by a community network (EUPAP, n.d.).

Patients are provided with personalized advice documented in their medical records, which include recommended activities, potential contraindications and a follow-up plan. The follow-up typically occurs after six months, to reassess and maintain motivation. Additionally, patients may be directed to community exercise programs, although they usually bear the cost (Andersen et al., 2018).

The PAP program primarily targets individuals who are not sufficiently active, are overweight, or have chronic conditions, which could be alleviated through increased physical activity. The program's implementation varies across Sweden, with healthcare professionals such as nurses, physiotherapists, midwives, dietitians and doctors all authorized to issue prescriptions. In some regions, there are even dedicated PAP coordinators or coaches (Andersen et al., 2018).

Although PAP is not centrally funded, certain projects, regional agreements, or partnerships with sports organizations provide financial support. The program is continuously evolving, with updates made to resources like prescription forms and handbooks (EUPAP, n.d.).

An evaluation of the PAP program revealed that participants significantly increased their physical activity, resulting in health improvements. With the current coverage rate at 0.56%, the program is projected to contribute an additional 737 life years (LY) and 979 disability-adjusted life years (DALYs) by 2050. If coverage increases to 2.39%, these figures could rise to 10,995 LYs and 13,113 DALYs. The program has the potential to notably reduce cardiovascular diseases, mental health conditions and more besides (Andersen et al., 2018) (EUPAP, n.d.).

5.2 FINLAND: A PIONEER IN INTEGRATING PHYSICAL ACTIVITY INTO THE SCHOOL DAY

Finland is well-known for its education system, which prioritizes the overall well-being of students, including their physical health. The Finnish government, through the UKK Institute, recommends that children aged 7 to 17 engage in at least 60 minutes of moderate to vigorous physical activity each day, encompassing activities that build endurance, strength and flexibility (JAMK University) (Global Education Park Finland, 2017).

In line with these recommendations, Finnish schools are mandated to incorporate physical activity into students' daily routines, ensuring they regularly engage in exercise. This combination of policy and practice serves as a benchmark for other nations (Liikkuva Koulo, 2024).

In this context, the "Schools on the Move" program is a national initiative aimed at fostering a physically active culture in schools. The program covers over 90% of Finnish municipalities and involves 80% of comprehensive schools. Its goal is to ensure that students engage in at least one hour of physical activity daily through various means, including physical education classes, active commuting and physically active breaks during the school day (Aalto-Nevalainen, 2023) (Niemi, 2020).

Key features of the program include:

- Mandatory physical activity: Finnish schools are required to provide students with daily physical activity, which often includes physical education classes and other forms of physical exercise integrated into the school day (Aalto-Nevalainen, 2023) (Blom et al., 2018).
- Frequent breaks: Finnish students benefit from short breaks (typically 15 minutes) after every 45 minutes of classroom instruction, often involving outdoor play and physical activity (HundrED.org, 2024).
- Daily PE lessons: Many schools offer daily PE lessons or organize structured physical activities, ensuring that students receive at least one hour of physical exercise each day (Liikkuva Koulo, 2024).
- Emphasis on outdoor activities: Outdoor activities and sports are strongly encouraged, reflecting Finland's cultural emphasis on outdoor living and a connection with nature (Global Education Park Finland, 2017)

Scientific studies, evaluating the program's implementation and effectiveness, have shown significant increases in physical activity during recess and throughout the school day, as well as a reduction in sedentary time. The program has positively impacted on learning and academic performance, with physical exercise improving cognitive abilities, concentration, behavior and student satisfaction. Overall, the program has effectively created a physically active culture in schools, leading to increased physical activity amongst students (Blom et al., 2018).

5.3 POLICIES AND REGULATORY FRAMEWORKS PROMOTING PHYSICAL EXERCISE FOR PUBLIC HEALTH IN CHINA

Over the past two decades, China has made significant strides in promoting an active lifestyle, making sports and fitness a central aspect of its economy. The 14th Five-Year Plan for Sports Development, covering the years 2021 to 2025, aims to establish China as a global sports power, with objectives that extend beyond elite athletes to include the general population. The government is increasingly encouraging fitness to address social and health challenges, particularly amongst school-aged youth and senior citizens (Shandong, 2024) (Government of China).

A key component of this national strategy is the National Fitness Plan, which focuses on increasing mass participation in physical activities. The plan aims to enhance public fitness infrastructure and improve access to sports facilities, particularly in urban and rural areas. It promotes integrating fitness activities into daily life, supports public sports events and expands the availability of fitness guidance and services. One of the primary goals is to incorporate fitness activities into the daily routines of a significant portion of the population, thereby improving overall public health. The plan aims for 38.5% of the population to engage regularly in exercise and to boost the sports industry's value to $774 billion by 2025 (Shandong, 2024) (Dezan Shira & Associates, 2024).

To achieve these goals, the plan emphasizes increasing fitness accessibility across the country. It aims to have more than two sports instructors for every 1,000 residents, to create or expand 2,000 fitness venues, and to refurbish over 5,000 fitness facilities. By 2025, China plans to ensure that every county, town and village has full coverage of fitness facilities, meaning all citizens should be within a 15-minute walk of a place to exercise (Government of China).

The legal framework supporting these broader goals is provided by the Sports Law, which ensures that the development of sports and physical exercise is legally structured and regulated. For example, following the National Fitness Plan, which requires students to participate in at least one hour of physical exercise daily, a revision of the Sports Law mandates that schools implement this measure, addressing China's primary concern regarding public and youth fitness (Global Times, 2022).

Together with the Sports Law, the Healthy China Initiative, introduced by the State Council in 2019, integrates these efforts within the broader context of public health. The initiative, which has an action plan covering 2019 to 2030, emphasizes the health benefits of an active lifestyle for disease prevention and the management of chronic conditions. Specifically, it highlights the importance of healthy habits, such as regular exercise, balanced diets and avoiding alcohol and smoking to prevent health issues like psychological disorders, myopia, childhood obesity, diabetes and other conditions (Koty, 2022).

5.4 PROMOTION OF PHYSICAL EXERCISE IN OUTDOOR PUBLIC SPACES IN BOGOTÁ, COLOMBIA

In Bogotá, the Public Policy for Sport, Recreation, Physical Activity, Parks and Facilities 2022-2032 aims to improve the conditions and opportunities for practicing sports, recreation and physical activity in the city. This policy also focuses on the development and maintenance of parks and sports facilities across the Capital District (Cultura, Recreación y Deporte, 2015) (Instituto Distrital de Recreación y Deporte, 2022).

As part of this policy, the "Gimnasios al Parque" programme has been implemented to facilitate access to physical activity by offering outdoor gyms in parks and other public spaces. These spaces provide citizens with opportunities to participate in guided and free training sessions. The programme offers various services, including functional training, calisthenics and muscle strengthening, Tabata, endurance and interval training sessions are all available in neighbourhood, zonal and metropolitan parks throughout the district (Instituto Distrital de Recreación y Deporte, n. d.).

5.5 CORPORATE FITNESS UNDER JOHNSON & JOHNSON'S EMPLOYEE WELLNESS PROGRAMS

Johnson & Johnson (J&J) places a strong emphasis on providing convenient access to wellness resources, as part of their broader health and well-being strategy. This accessibility is a key element in ensuring that employees can easily integrate health-promoting activities into their daily routines (Johnson & Johnson, n.d.) (Shapiro, 2018) .

Several data and studies have demonstrated throughout the years that the company's wellness programs have led to reductions in smoking, high blood pressure and physical inactivity amongst employees (The Health Project, n.d.).

Likewise, studies have shown that J&J's wellness programs are not just beneficial for employees' health but also have a significant economic impact. For example, from 2002 to 2008, J&J saved approximately $250 million in healthcare costs, with a return of $2.71 for every dollar spent on wellness programs (Quelch, 2015) (Johnson & Johnson, n.d.).

Out of the diverse range of measures and services that the company provides to its employees, the following include a strong component on promoting physical exercise:

On-Site Fitness Centre: J&J has established fitness centers at various work locations, which are easily accessible to employees. These on-site gyms are equipped with exercise equipment and facilities that encourage regular physical activity. The convenience of having these centers within or close to the workplace eliminates the time and logistical barriers that often prevent employees from exercising regularly (Business Group on Health, 2020).

Health and Wellness Digital Platforms: The "Healthy & Me" digital platform is a key resource that J&J provides for its employees. This platform is accessible via smartphones, tablets and computers, allowing employees to track their health metrics, engage in fitness challenges and receive personalized wellness recommendations. By making these resources available online, J&J ensures that employees can manage their health proactively, regardless of their location or work schedule (Johnson & Johnson, 2024)

Flexibility in Program Participation: J&J offers flexibility as to how employees can engage with wellness programs, including options to participate in health webinars and training sessions at times that suit them. For example, webinars on topics like strength training and healthy living are scheduled both during the day and in the evening, allowing employees to join at their convenience, whether at work or at home (Quelch, 2015).

Physical Wellness Integration in the Work Environment: J&J integrates physical wellness into the daily work environment by offering features like on-site walking paths, exercise breaks and ergonomic workstations. These initiatives are designed to encourage movement throughout the workday, making physical activity a seamless part of the work routine (Johnson & Johnson, n.d.).

Incentives for Participation: To further encourage engagement, J&J provides incentives for participating in wellness activities. Employees can earn discounts on health insurance or other benefits by engaging in fitness programs, completing health assessments, or participating in wellness challenges. These incentives not only make wellness activities more appealing but also reward employees for taking steps to improve their health (Quelch, 2015).

One clear indicator of the success of J&J's wellness program is the high participation rate in their Health Risk Assessments (HRAs), which exceeds 80%. This high level of engagement is partly due to incentives, such as reducing personal health insurance contributions by $500 annually for employees who complete an HRA and receive recommended health counselling (Johnson & Johnson, n.d.).

This also allows J&J to tailor its wellness programs to specific health needs and to tailor health interventions across different business units, ensuring that programs like physical exercise are relevant and effectively targeted to the right employee groups (Johnson & Johnson, n.d.).

In 2023, nearly 15,000 employees participated in well-being learning courses, which are part of J&J's commitment to employee health. Additionally, 88% of employees surveyed in the same year agreed that the company supports their health and well-being, indicating a high level of engagement with the available wellness resources, including digital tools like Healthy & Me (Johnson & Johnson, 2024).

Based on J&J and similar case studies on corporate Fitness, several studies conclude that corporate fitness programs cannot merely offer workers a few passes to a fitness center and nutrition information in the cafeteria. Some of the essential pillars for success include: engaged leadership at multiple levels; strategic alignment with the company's identity and aspirations; a design that is broad in scope and high in relevance and quality; broad accessibility; internal and external partnerships; and effective communications (Business Group on Health, 2020) (Johnson & Johnson, 2024).

6 Rewarding physical exercise as a strategy of health insurance companies to reduce health costs: Vitality program by Discovery (South Africa)

The Vitality program by Discovery, originating in South Africa, exemplifies the integration of wellness initiatives with health insurance to promote healthier lifestyles and reduce healthcare costs. This program has expanded globally, integrating with insurers in various countries, including the USA, Canada and Asia (Gore et al., 2017) (AIA Australia, n.d.).

The Vitality program operates on a points-based system where members earn points for engaging in health-promoting activities such as exercise, health screenings and healthy eating. As members accumulate points, they advance through different tiers (Bronze, Silver, Gold and Platinum), with each tier offering increasingly valuable rewards. These rewards range from discounts on insurance premiums and fitness devices to travel vouchers. The program is highly personalized, utilizing data analytics to set individual health goals and track progress, often through wearable technology like Fitbit and Apple Watch (Wanni Arachchige Dona et al., 2021).

Vitality's success in reducing healthcare costs is well-documented. Studies and annual reports from Discovery indicate that active members experience significant improvements in health metrics, such as BMI, cholesterol and blood pressure, leading to lower rates of chronic diseases. This reduction in chronic diseases has translated into a decreased need for expensive medical treatments, thereby lowering overall healthcare costs. Reports, including one from the Harvard Business Review, noted that Vitality members generate up to 30% lower hospitalization costs and have longer lifespans compared to non-members. These positive health outcomes create a virtuous cycle where healthier members lead to reduced insurance claims, resulting in savings that can be passed on to other policyholders through lower premiums (Gore et al., 2017) (AIA Australia, n.d.).

The program’s effectiveness is supported by various sources, including case studies and academic research, highlighting how it has transformed the insurance model by aligning the interests of insurers with the health outcomes of their clients. This shared-value approach has proven to be a successful model for integrating health incentives with insurance, leading to significant benefits for members, insurers and society at large (Wanni Arachchige Dona et al., 2021).

Box 3: The Role of Fitness Apps and IoT Gadgets in Enhancing Exercise Adherence

The integration of fitness apps and IoT gadgets is playing a significant role in the engagement by individuals with physical exercise, enhancing both goal setting and adherence to routines. These technologies utilize real-time data, personalized feedback and community engagement to support consistent exercise habits (Deb, 2024) (Fabbrizio et al., 2023).

One key benefit is the ability to personalize the exercise experience. Research shows that users who receive tailored workout plans and real-time feedback are more likely to maintain their routines. For instance, wearable devices with personalized coaching help users stick to physical activity guidelines by adapting to their needs and providing customized advice that sustains motivation over time (Fabbrizio et al., 2023).

Social sharing in fitness apps also plays a crucial role in promoting exercise adherence. The social sharing features allow users to share progress, compete with friends and connect with a broader community, which significantly increases physical activity levels. The sense of community and friendly competition serves as a powerful motivator, pushing individuals to achieve more than they might on their own (Kao, Nawata, & Huang, 2019) (Ozdamli & Milrich, 2023).

Gamification can also enhance fitness by making exercise more fun, rewarding and social. Users can have a more enjoyable experience and become inspired to exercise more frequently by adding gaming aspects to fitness apps. However, more than technology is needed to motivate individuals to exercise regularly. The success of gamification in fitness apps depends on the commensurability of game elements (Kao, Nawata, & Huang, 2019) (Hu & Li, 2024) (Grech, Briguglio, & Said, 2024).

Moreover, the ability to monitor progress in real-time is another significant advantage. Wearable devices provide continuous feedback on health metrics like heart rate, steps taken and sleep quality, empowering users to make informed decisions about their healthy habits (Deb, 2024) (Fabbrizio et al., 2023).

In summary, fitness apps and IoT gadgets offer a comprehensive, data-driven approach to exercise, which enhances adherence through personalization, community support and real-time feedback. These tools can significantly help users maintain consistent exercise routines, leading to better health outcomes and a more active lifestyle.

7 RECOMMENDATIONS

To address the complex issue of exercise adherence and harness its enormous benefits for mental health, well-being and society, a mix of ambitious public policies and innovative private initiatives is necessary at multiple levels (global, national, local and community) and through multidisciplinary approaches. A significant cultural shift is needed to build an enabling environment, which fosters a movement culture, integrating physical exercise and stretching into daily routines.

This shift requires a comprehensive strategy, which includes the following key recommendations:

1. Policy level: developing comprehensive public strategies

Develop national strategies: National governments should develop ambitious public strategies in consultation with key experts, organizations and representatives from relevant sectors, such as public health and fitness. Engaging stakeholders from the outset ensures that strategies are well-informed, robust and aligned with the needs and perspectives of those involved. These strategies, aiming at a systemic change, should be accompanied by detailed implementation plans and sufficient budgets for a comprehensive package of measures, including:

New regulations: Formulate regulations that encourage physical activity across multiple sectors, requiring companies, schools, hospitals and other institutions to promote exercise adherence. This includes setting standards for workplace wellness programs, mandating physical education in schools and establishing guidelines for urban planning that prioritize active transportation and recreational spaces.

Integrating exercise into healthcare systems: Incorporate exercise into healthcare systems as a core component of treatment and prevention strategies. Healthcare providers should be trained and supported to prescribe physical activity as part of treatment plans, supported by collaborations with fitness trainers and physiotherapists. This integration should follow a user-friendly approach, including initial assessments, brief interventions and continued support using educational resources and digital tools (O'Reagan et al., 2021).

Fiscal incentives: Implement fiscal incentives to motivate individuals to participate in physical activity initiatives. National and local governments should provide economic incentives (e.g., subsidies, tax reductions) to make physical activity programs, sports infrastructure and professional services more accessible. Despite the lack of public initiative on this lever, there is scientific evidence that modest incentives could increase physical activity for interventions of short and long durations - and after incentives are removed (Mitchell et al., 2020).

Impact measurement: Establish robust mechanisms for measuring the impact of new regulations and incentives. This includes selecting appropriate indicators to track improvements in physical activity levels, health outcomes and economic benefits. Regular

evaluation and reporting will help refine strategies with engaged stakeholders and demonstrate their value.

2. Social support mechanisms: ensuring accessibility for all

Ensure that exercise facilities are accessible to all socioeconomic groups and address gender-specific barriers, particularly for those with higher rates of sedentary behavior and lower socioeconomic status. Women may face unique challenges, such as safety concerns and cultural restrictions. Testing measures with different communities, incorporating both behavioral and gender perspectives, can identify effective strategies based on various socioeconomic and gender-specific factors. Prioritize investments in public gyms, sports facilities and green spaces to bridge the accessibility gap and make exercise opportunities available to underserved populations. New facilities should also be properly managed by professionals who ensure their proper use, motivate users and foster community engagement.

3. Urbanization and infrastructure: enhancing physical activity environments

Urbanization affects sedentary behaviors across socioeconomic and gender groups. To address these challenges, create environments where physical activity is accessible and encouraged, fostering healthier communities that support active lifestyles. Invest in infrastructure that prioritizes walkability, cyclability and accessibility to recreational areas, integrating green spaces within urban settings. These efforts should consider the diverse needs of all community members, including safety measures and accommodations for different genders, ages and abilities.

4. Education: promoting early exposure to physical activity

Promote early exposure to physical activity to instill lifelong habits and reduce sedentary behavior in future generations. Implement mandatory physical education programs in schools and universities, which provide children and young people with lifelong fitness skills and knowledge. Educational policies should include at least one hour of physical exercise daily in curricula across different stages (infant, primary and secondary education). By integrating physical activity into educational curricula, young people can be equipped with the tools to maintain an active lifestyle throughout their lives.

5. Awareness campaigns: engaging the public through social media

Conduct awareness campaigns on social media to highlight the mental and physical health benefits of regular exercise and inspire people to take action. These campaigns should be innovative and focused on motivating individuals to incorporate exercise into their daily lives. Influencers can play a significant role by leveraging their platforms to spread awareness and encourage their audiences to adopt healthier lifestyles. By using creative content and targeted messaging, these campaigns can effectively reach diverse demographics, increasing public engagement in physical activity.

6. Workplace wellness: ensuring physical exercise in the workplace

Promote physical exercise in the workplace by integrating exercise promotion into companies' environment, health and safety strategies. Companies can significantly improve workers' health by implementing specific measures, such as workplace wellness programs, incentives for active commuting and the provision of fitness facilities. By fostering a culture of health and wellness, organizations can enhance employee well-being and productivity. Encouraging regular physical activity at work not only benefits individual health but also contributes to improved morale, reduced absenteeism and increased workplace efficiency.

7. Behavioral change strategies

Leverage behavioral change strategies to enhance physical exercise, drawing on previous applications in public health, education, environmental sustainability, corporate settings, healthcare and social services. Techniques, such as goal setting, self-monitoring, social support, incentives and environmental design can be effective in enhancing motivation, promoting exercise adherence and integrating physical activity into daily routines.

8. Health economics: measuring economic impact

Strengthen the use of health economics to assess the impact of physical activity, or the lack thereof, on significant public and private economic variables. Conduct comprehensive analyses to quantify healthcare savings, productivity gains and workforce participation improvements resulting from increased physical activity. These analyses can guide policy and investment decisions, demonstrating the broader economic benefits of promoting exercise adherence.

There is a need for more research and data collection, particularly in workplace settings. Whilst many studies have focused on healthcare, the economic effects of physical activity in workplaces remain underexplored. Developing methodologies and gathering data specific to workplaces will provide insights into how physical activity can enhance employee health, reduce absenteeism and boost productivity. By focusing on these areas, stakeholders can make informed decisions, which support exercise initiatives across various sectors.

9. Experience exchange: learning from others

Facilitate the exchange of experiences amongst national governments, cities, communities and organizations involved in promoting exercise adherence. Sharing best practices and lessons learned can provide valuable insights into successful strategies and common challenges. This collaborative approach can help align key priorities and drive efforts to improve exercise adherence worldwide. Additionally, positioning exercise adherence prominently on the international agenda encourages a unified commitment to fostering healthier, more active societies across the globe.

10. Boosting further research to advance knowledge on exercise adherence

Research on exercise adherence is a dynamic and evolving field, continually advancing as new technologies emerge and the connections between physical activity, mental health and overall well-being become clearer. To further enhance exercise adherence and optimize physical activity interventions, additional research is required across diverse areas and populations.

Key topics to be prioritized for future exploration include:

- **Snack exercises and short bouts of activity:** Investigate the effectiveness of integrating short, frequent bouts of physical activity ("snack exercises") into daily routines. Further research should focus on real-world applications, supporting the development of standardized definitions, understanding molecular mechanisms and the impact of these exercises on muscle health and overall fitness. Understanding the optimal frequency and intensity of these activities can offer a practical solution to adherence challenges.
- **Precision exercise:** Future research on precision exercise should focus on several key areas: understanding genetic and epigenetic factors, which influence individual exercise responses, the integration of wearable technology and AI, as well as the benefits of precision exercise for disease prevention, ageing, hormonal regulation, etc. Further areas include examining psychological outcomes, injury prevention through biomechanical analysis and microbiome-informed exercise prescriptions. Special attention should be given to demographic-specific strategies, including the cultural adaptation of exercise programs and targeted interventions for at-risk populations, such as the elderly, individuals with disabilities, or those with chronic illnesses. Research should also assess cost-effectiveness, ethical considerations and personalized recovery strategies.
- **Behavioral change strategies:** Further research is needed on how various psychological approaches can enhance physical activity adherence. Further research can explore techniques such as habit formation, motivational interviewing and cognitive-behavioral strategies. Investigating these approaches across different populations and settings can help develop interventions that sustain long-term behavior change.
- **Mental Health perspectives**: Investigating the relationship between exercise and mental health through various lenses could significantly enhance the field. For example, longitudinal studies on the mental health benefits of sustained exercise, especially in populations with mental health challenges, along with research on the integration of mindfulness techniques into exercise routines to boost psychological benefits and adherence, are key areas for exploration.
- **Technology and gamification:** Examine the role of gamification, virtual reality and wearable technologies in increasing motivation and engagement in physical activity. Understanding how these tools can sustainably improve exercise adherence is essential, particularly for sedentary and at-risk populations.

- **Workplace-based research:** Conduct studies on exercise adherence within different work environments, particularly focusing on the barriers posed by work conditions (e.g. through surveys in diverse work settings). Research should explore the long-term effectiveness of workplace wellness programs (e.g. through longitudinal studies), the impact of remote

work on physical activity and potential solutions to encourage exercise in various work settings.

- **Community-based and environmental interventions:** Investigate how urban design and community support networks can influence exercise participation. Research should explore the role of social capital, community characteristics and environmental factors in facilitating physical activity, particularly in underserved populations.

- **Equity and ethics in exercise promotion:** Explore ethical considerations and equity issues in expanding exercise programs. Key areas of focus should include ensuring equitable access to fitness resources for marginalized communities and addressing privacy concerns related to data collection in fitness apps and wearable devices.

8 MOTIVATE FURTHER RESEARCH

1. Addressing the integration of short bouts of physical activity into daily routines, the "snack exercises" (Wang et al., 2024):

Snack exercises involve short, frequent bouts of physical activity integrated into daily routines. They offer a practical solution to the adherence challenges posed by traditional exercise regimens. By removing the need for dedicated workout periods and specialized equipment, snack exercises make it easier for individuals to engage in regular physical activity without disrupting their daily schedules. The flexibility and convenience of snack exercises not only help in reducing daily sedentary behavior but also provide significant health benefits, such as improvements in cardiovascular fitness, metabolic health and muscle strength. This approach aligns well with the realities of modern life, where many people face significant barriers to maintaining consistent exercise routines.

However, whilst snack exercises show as a feasible alternative to conventional workouts, especially for sedentary populations, several areas require further research to fully understand their potential and optimize their application:

i. **Application in real-world settings**
   Most studies on snack exercises have been conducted in controlled environments. More research is needed to explore their effectiveness in real-world settings, such as schools, workplaces and retirement homes.
ii. **Standardized definition**
   There is currently no universally accepted definition of snack exercises. Establishing clear guidelines on the duration and intensity of these exercises is necessary to differentiate them from other short, high-intensity workouts.
iii. **Molecular mechanisms**
   More studies are needed to investigate the molecular mechanisms underlying the benefits of snack exercises, particularly how they improve physical function and metabolic health.
iv. **Impact on muscle health**
   Further research should explore the effects of snack exercises on muscle morphology and function, especially in sedentary adult populations.
v. **Optimal frequency and intensity**
   Determining the optimal frequency and intensity of snack exercises is crucial for maximizing their health benefits, particularly in terms of muscle growth and cardiovascular fitness.

2. <u>Developing research on precision exercise:</u>

Here are some topics for future research on precision exercise that could contribute significantly to the field: (Kubis et al., 2024)

i. **Genetic Determinants of Exercise Response**

Investigate how specific genetic variations influence individual responses to different types of exercise (e.g., aerobic vs. anaerobic) and how these insights can be used to tailor exercise programs more effectively.

ii. **Precision Exercise for Disease Prevention and Management**
Explore the efficacy of precision exercise in preventing and managing chronic diseases, such as type 2 diabetes, cardiovascular disease and cancer. Research could focus on how individualized exercise plans compare to standard recommendations in improving clinical outcomes.

iii. **Integration of Wearable Technology and AI in Precision Exercise**
Examine the role of wearable technology and artificial intelligence in enhancing the precision of exercise programs. This could include studies on the accuracy and effectiveness of real-time data collection and algorithm-driven adjustments to exercise routines.

iv. **Psychological and Behavioral Outcomes of Precision Exercise**
Study the psychological impacts of precision exercise programs, including motivation, adherence and mental health outcomes. Research could explore how individualized plans affect long-term exercise behavior compared to standard approaches.

v. **Longitudinal Effects of Precision Exercise on Ageing**
Investigate how precision exercise can influence the aging process over time, including its impact on longevity, functional independence and quality of life in older adults.

vi. **Cost-Effectiveness of Precision Exercise Programs**
Conduct cost-benefit analyses to determine the economic feasibility of implementing precision exercise programs on a large scale. This research could compare the long-term healthcare savings with the upfront costs of personalized assessments and technologies.

vii. **Ethical Considerations in Precision Exercise**
Explore the ethical implications of precision exercise, particularly in terms of accessibility, data privacy and the potential for exacerbating health inequalities. Research could focus on how to ensure that precision exercise benefits are equitably distributed.

viii. **The Role of Epigenetics in Exercise Prescription**
Examine how epigenetic factors (changes in gene expression due to environmental influences) affect exercise response and recovery. This research could lead to more nuanced exercise prescriptions, based on an individual's epigenetic profile.

ix. **Impact of Precision Exercise on Hormonal Regulation**
Study how precision exercise can be used to optimize hormonal health, particularly in populations with hormonal imbalances, such as those undergoing menopause, andropause, or thyroid disorders.

x. **Personalized Recovery Strategies in Precision Exercise**
Investigate personalized recovery protocols that complement precision exercise plans, including optimal rest periods, nutrition and active recovery techniques tailored to individual needs.

xi. **Biomechanical Analysis for Injury Prevention**
Explore how precision exercise programs can incorporate biomechanical analysis to prevent injuries in athletes and the general population. Research could focus on identifying risk factors and designing exercises that correct imbalances or weaknesses.

xii. **Microbiome and Precision Exercise**
Study the relationship between the gut microbiome and exercise response. Research could investigate how variations in the microbiome affect physical performance and recovery, leading to microbiome-informed exercise prescriptions.

xiii. **Impact of Precision Exercise on Cognitive Function**
Investigate the effects of precision exercise on cognitive health, particularly in ageing populations. Research could explore how tailored physical activity can prevent or delay cognitive decline.

xiv. **Cultural and Demographic Influences on Precision Exercise**
Examine how cultural, demographic and socioeconomic factors influence the design and effectiveness of precision exercise programs. Research could focus on how to customize programs for diverse populations.

xv. **Precision Exercise in Pediatric Population**
Research the application of precision exercise in children and adolescents, focusing on how individualized exercise programs can support healthy growth, development and the management of pediatric conditions like obesity or ADHD.

These topics can help advance the field of precision exercise, leading to more effective, personalized and accessible exercise interventions, which benefit a wide range of individuals and communities.

9 REFERENCES

9.1 BIBLIOGRAPHY CH.1: INTRODUCTION

1. World Health Organisation. (2022a). Global status report on physical activity 2022. World Health Organization. https://www.who.int/publications/i/item/9789240059153
2. World Health Organisation. (2022b). Mental disorders. https://www.who.int/news-room/fact-sheets/detail/mental-disorders#:~:text=In%202019%2C%201%20in%20every,of%20the%20COVID%2D19%20pandemic
3. World Health Organisation. (2022c). World mental health report: Transforming mental health for all. World Health Organisation. https://www.who.int/publications/i/item/9789240049338
4. World Obesity Federation. (2023). World Obesity Atlas 2023 (T. Lobstein, R. Jackson-Leach, J. Powis, H. Brinsden, & M. Gray, Compilers; J. Clarkson, Designer). World Obesity Federation. https://s3-eu-west-1.amazonaws.com/wof-files/World_Obesity_Atlas_2023_Report.pdf

9.2 BIBLIOGRAPHY CH. 2: EXERCISE ADHERENCE AND WELL BEING

1. Alexandratos, K., Barnett, F., & Thomas, Y. (2012). The impact of exercise on the mental health and quality of life of people with severe mental illness: A critical review. British Journal of Occupational Therapy, 75, 48-60. https://doi.org/10.4276/030802212X13286281650956
2. Ballester-Martínez, O., Baños, R., & Navarro-Mateu, F. (2022). Actividad física, naturaleza y bienestar mental: una revisión sistemática. Cuadernos de Psicología del Deporte, 22(2), 62-84. Retrieved August 20, 2024, from http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1578-84232022000200006&lng=es&tlng=es
3. Ben Singh, Timothy Olds, Rachel Curtis, Dorothea Dumuid, Rosa Virgara, Amanda Watson, Kimberley Szeto, Edward O'Connor, Ty Ferguson, Emily Eglitis, Aaron Miatke, Catherine E. M. Simpson, & Carol Maher. (2022). Effectiveness of physical activity interventions for improving depression, anxiety and distress: An overview of systematic reviews. Retrieved from https://bjsm.bmj.com/content/57/18/1203
4. Better Health Channel. (n.d.). Exercise and mental health. Retrieved from https://www.betterhealth.vic.gov.au/health/healthyliving/exercise-and-mental-health

5. Cámara Oficial de Comercio, Industria y Servicios de Madrid. (n.d.). Presentación del Libro Blanco de Salud Mental y Emocional. Retrieved from https://www.camaramadrid.es/evento/-/item/evento/9416/presentacion-del-libro-blanco-de-salud-mental-y-emocional
6. Cammisuli, D. M., Franzoni, F., Fusi, J., Scarfò, G., & Castelnuovo, G. (2023). Engagement in a structured physical activity programme and its effects upon health-related quality of life in elderly women: An observational study. Frontiers in Psychology, 14, 1135433. https://doi.org/10.3389/fpsyg.2023.1135433
7. Chekroud, S. R., Gueorguieva, R., Zheutlin, A. B., Paulus, M., Krumholz, H. M., Krystal, J. H., & Chekroud, A. M. (2018). Association between physical exercise and mental health in 1.2 million individuals in the USA between 2011 and 2015: A cross-sectional study. The Lancet Psychiatry, 5(9), 739-746. https://doi.org/10.1016/S2215-0366(18)30227-X
8. Comunidad de Madrid. (n.d.). Salud mental. Retrieved from https://www.comunidad.madrid/servicios/salud/salud-mental
9. Craft, L. L., & Perna, F. M. (2004). The Benefits of Exercise for the Clinically Depressed - PMC. NIH. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC474733/
10. de Pedro-Cuesta, J., Saiz-Ruiz, J., Roca, M., & Noguer, I. (2016). Salud mental y salud pública en España: Vigilancia epidemiológica y prevención. Psiquiatría Biológica, 23(2), 67-73. https://doi.org/10.1016/j.psiq.2016.03.001
11. Granero-Jiménez, J., López-Rodríguez, M. M., Dobarrio-Sanz, I., & Cortés-Rodríguez, A. E. (2022). Influence of physical exercise on psychological well-being of young adults: A quantitative study. International Journal of Environmental Research and Public Health, 19(7), 4282. https://doi.org/10.3390/ijerph19074282
12. Jianchang Ren & Haili Xiao. (2024). Exercise for mental well-being: Exploring neurobiological advances and intervention effects in depression. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10381534/
13. Kathleen Mikkelsen, Lily Stojanovska, Momir Polenakovic, Marijan Bosevski, & Vasso Apostolopoulos. (2017). Exercise and mental health. Retrieved from https://www.sciencedirect.com/science/article/pii/S0378512217308563
14. Lynette L. Craft, Ph.D. & Frank M. Perna. (2004). The Benefits of Exercise for the Clinically Depressed - PMC. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC474733/
15. Mahindru, A., Patil, P., & Agrawal, V. (2023). Role of physical activity on mental health and well-being: A review. Cureus, 15(1), e33475. https://doi.org/10.7759/cureus.33475
16. Martínez, S. F. A., Turbay Posada, M. J., Rodríguez Díaz, M. A., Polo Vargas, J. D., & Gutiérrez Carvajal, O. I. (2022). Diseño del trabajo, bienestar y salud mental: Revisión de literatura. Psicología desde el Caribe, 39(1), e200. Retrieved August 20, 2024, from

http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0123-417X2022000100001&lng=en&tlng=es

17. Mayo Clinic Staff. (2023). Depression and anxiety: Exercise eases symptoms. Retrieved from https://www.mayoclinic.org/diseases-conditions/depression/in-depth/depression-and-exercise/art-20046495
18. NHS. (n.d.). Benefits of exercise. Retrieved from https://www.nhs.uk/live-well/exercise/exercise-health-benefits/#:~:text=Research%20shows%20that%20physical%20activity,depression%2C%20dementia%20and%20Alzheimer%27s%20disease
19. Rivera-Torres, S., Fahey, T. D., & Rivera, M. A. (2019). Adherence to exercise programmes in older adults: Informative report. Gerontology and Geriatric Medicine, 5. https://doi.org/10.1177/2333721418823604
20. Salman, A., Sellami, M., Al-Mohannadi, A. S., & Chun, S. (2019). The Associations between Mental Well-Being and Adherence to Physical Activity Guidelines in Patients with Cardiovascular Disease: Results from the Scottish Health Survey. International Journal of Environmental Research and Public Health, 16(19), 3596. https://doi.org/10.3390/ijerph16193596
21. UNED. (n.d.). La salud mental en contextos educativos: Prevención, intervención y promoción. Retrieved from https://extension.uned.es/actividad/idactividad/36399
22. Vella, S. A., Aidman, E., Teychenne, M., Smith, J. J., Swann, C., Rosenbaum, S., White, R. L., & Lubans, D. R. (2023). Optimising the effects of physical activity on mental health and wellbeing: A joint consensus statement from Sports Medicine Australia and the Australian Psychological Society. Journal of Science and Medicine in Sport, 26(2), 132-139. https://doi.org/10.1016/j.jsams.2023.01.001
23. World Health Organization. (2022). Mental health: Strengthening our response. Retrieved from https://www.who.int/es/news-room/fact-sheets/detail/mental-health-strengthening-our-response
24. World Health Organisation. (2024). Physical activity. Retrieved from https://www.who.int/news-room/fact-sheets/detail/physical-activity
25. Wu, K., Wang, S., Ding, T., & Li, Y. (2023). The direct effect of exercise on the mental health of scientific and technological professionals and the mediating effects of stress, resilience and social support. Frontiers in Public Health, 11, 1074418. https://doi.org/10.3389/fpubh.2023.1074418
26. Zhang, Y., & Jiang, X. (2023). The effects of physical activity and exercise therapy on frail elderly depression: A narrative review. Medicine, 102(34), e34908. https://doi.org/10.1097/MD.0000000000034908

9.3 BIBLIOGRAPHY CH. 3: STATUS QUO & ADDRESSING THE BARRIERS TO EXERCISE ADHERENCE

1. Begdache, L., & Patrissy, C. M. (2021). Customisation of diet may promote exercise and improve mental wellbeing in mature adults: The role of exercise as a mediator. Journal of Personalised Medicine, 11(5), 435. https://doi.org/10.3390/jpm11050435
2. Bethancourt, H. J., Rosenberg, D. E., Beatty, T., & Arterburn, D. E. (2019). Barriers to and facilitators of physical activity programme use among older adults. Clinical Medicine & Research, 17(2), 113-121. https://doi.org/10.3121/cmr.2019.1469
3. Dalle Grave, R. (2020). Nutrition and fitness: Mental health. Nutrients, 12, 1804. https://doi.org/10.3390/nu12061804
4. Ding, D., Van Buskirk, J., Partridge, S., Clare, P., Giovannucci, E., Bauman, A., Freene, N., Gallagher, R., & Nguyen, B. (2024). The association of diet quality and physical activity with cardiovascular disease and mortality in 85,545 older Australians: A longitudinal study. Journal of Sport and Health Science, 13(6), 841-850. https://doi.org/10.1016/j.jshs.2024.05.011
5. Gao, W., Sanna, M., Chen, Y.-H., et al. (2024). Occupational sitting time, leisure physical activity and all-cause and cardiovascular disease mortality. JAMA Network Open, 7(1), e2350680. https://doi.org/10.1001/jamanetworkopen.2023.50680
6. Graham, H. L. (2021). Exercise adherence. In D. Gu & M. E. Dupre (Eds.), Encyclopedia of Gerontology and Population Ageing. Springer. https://doi.org/10.1007/978-3-030-22009-9_807
7. Jones, C., Chandarana, S., Vyas, A., & Napolitano, M. (2024). Attitudes, barriers and motivators towards daily walking and a mobile app to increase walking amongst women: Web-based anonymous survey. JMIR Formative Research, 8, e48668. https://doi.org/10.2196/48668
8. Liu, Y., Crisafulli, et al. (2024). Precision exercise prescription: Data-driven strategies for neuromuscular and cardiovascular training across athletes, healthy individuals and chronic disease populations. Manuscript submission for Frontiers in Physiology and Frontiers in Sports and Active Living. Wuhan Sports University. https://www.frontiersin.org/research-topics/61484/precision-exercise-prescription-data-driven-strategies-for-neuromuscular-and-cardiovascular-training-across-athletes-healthy-individuals-and-chronic-disease-populationstiers
9. Mikolaizak, A. S., Taraldsen, K., Boulton, E., Gordt, K., Maier, A. B., Mellone, S., Hawley-Hague, H., Aminian, K., Chiari, L., Paraschiv-Ionescu, A., Pijnappels, M., Todd, C., Vereijken, B., Helbostad, J. L., & Becker, C. (2022). Impact of adherence to a lifestyle-integrated programme on physical function and behavioural complexity in young older adults at risk of

functional decline: A multicentre RCT secondary analysis. BMJ Open, 12(10), e054229. https://doi.org/10.1136/bmjopen-2021-054229
10. Morris, J. N., & Hardman, A. E. (2021). Walking to health. Sports Medicine, 23(5), 306-332. https://doi.org/10.2165/00007256-199723050-00004
11. Rivera, E., Smith, C., & Hesketh, K. D. (2024). Priority populations' experiences of the accessibility and inclusion of recreation centres: A qualitative study. BMC Public Health, 24(1), 205. https://doi.org/10.1186/s12889-023-17595-3
12. Saghayi, M., et al. (2020). Brain network topology predicts participant adherence to mental training programmes. Network Neuroscience, 4(3), 528–555. https://doi.org/10.1162/netn_a_00136
13. Scheller, D. A., & Bachner, J. (2024). Subjective walkability perceived by children and adolescents living in urban environments: A study protocol for participatory methods and scale development in the WALKI-MUC project. PLoS One, 19(3), e0299208. https://doi.org/10.1371/journal.pone.0299208
14. Schutzer, K. A., & Graves, B. S. (2020). Barriers and motivations to exercise in older adults. Preventive Medicine, 39(5), 1056-1061. https://doi.org/10.1016/S0091-7435(04)00186-6
15. Sirotiak, Z., Brellenthin, A. G., Hariharan, A., Welch, A. S., Meyer, J. D., & Franke, W. D. (2024). Psychological correlates of physical activity amongst adults living in rural and urban settings. Frontiers in Psychology, 15, 1389078. https://doi.org/10.3389/fpsyg.2024.1389078
16. Watson, J., Beedie, C., & Galloway, S. (2024). A behavioural perspective for improving exercise adherence. Sports Medicine - Open, 10(1). https://doi.org/10.1186/s40798-024-00714-8
17. World Health Organisation. (2018). Global action plan on physical activity 2018-2030. World Health Organisation.
18. World Health Organisation. (2022). Global status report on physical activity 2022. World Health Organisation.
19. World Health Organisation. (n.d.). Global recommendations on physical activity for health. World Health Organisation.

9.4 BIBLIOGRAPHY CH. 4: STRATEGIES TO IMPROVE EXERCISE ADHERENCE

1. Agencia Nacional de Evaluación de la Calidad y Acreditación. (n.d.). Título de grado en ciencias de la actividad física y del deporte. https://www.aneca.es/documents/20123/63950/libroblanco_deporte_def.pdf/43809f93-1aa1-11cd-4983-60161d31d6a9?t=1654601717192
2. Belmonte Darraz, S., González-Roldán, A. M., de María Arrebola, J., & Montoro-Aguilar, C. I. (2021). Impacto del ejercicio físico en variables relacionadas con el bienestar emocional y

funcional en adultos mayores. Revista Española de Geriatría y Gerontología, 56(3), 136-143. https://doi.org/10.1016/j.regg.2021.01.00

3. Brickwood, K. J., Watson, G., O'Brien, J., & Williams, A. D. (2019). Consumer-based wearable activity trackers increase physical activity participation: Systematic review and meta-analysis. JMIR mHealth and uHealth, 7(4), e11819. https://doi.org/10.2196/11819
4. Cibanal, S. (2023). Tendencias tecnológicas en la industria del fitness 2024. Trainingym. https://blog.trainingym.com/es/blog/tendencias-tecnologicas-en-la-industria-del-fitness-2024
5. Coaching Camp. (n.d.). Estrategias para potenciar la motivación en el ejercicio. Coaching Camp. https://www.coachingcamp.es/fitness-coaching/estrategias-potenciar-motivacion-ejercicio/
6. Collado-Mateo, D., Lavín-Pérez, A. M., Peñacoba, C., Del Coso, J., Leyton-Román, M., Luque-Casado, A., & others. (2021). Key factors associated with adherence to physical exercise in patients with chronic diseases and older adults: An umbrella review. International Journal of Environmental Research and Public Health, 18(4), 1-24. https://www.researchgate.net/publication/349449726_Key_Factors_Associated_with_Adherence_to_Physical_Exercise_in_Patients_with_Chronic_Diseases_and_Older_Adults_An_Umbrella_Review
7. Comunidad de Madrid. (n.d.-a). Programa Salud Activa. Comunidad de Madrid. https://www.comunidad.madrid/servicios/deportes/programa-salud-activa
8. FasterCapital. (2024). Innovación en dispositivos portátiles de fitness: Cómo la innovación en dispositivos portátiles de fitness está revolucionando el panorama de las empresas emergentes. FasterCapital. https://fastercapital.com/es/contenido/Innovacion-en-dispositivos-portatiles-de-fitness-Como-la-innovacion-en-dispositivos-portatiles-de-fitness-esta-revolucionando-el-panorama-de-las-empresas-emergentes.html
9. FasterCapital. (n.d.). Innovaciones en tecnología portátil para fitness. FasterCapital. https://fastercapital.com/es/tema/innovaciones-en-tecnolog%C3%ADa-port%C3%A1til-para-fitness.html
10. García-Allen, J. (2016). Autocontrol: 7 consejos psicológicos para mejorarlo. Psicología y Mente. https://psicologiaymente.com/psicologia/autocontrol-consejos
11. González-Calvo, G., Bores-García, D., Hortigüela-Alcalá, D., & Barba-Martín, R. A. (2018). Adherencia a un programa de ejercicio físico en los ámbitos educativos y extraescolar [Adherence to a physical exercise programme in school and extracurricular activities]. Apunts Educación Física y Deportes, 34(134), 39-54. Institut Nacional d'Educació Física de Catalunya. https://www.redalyc.org/journal/5516/551657187003/html/
12. Lappset. (n.d.). El deporte al aire libre fomenta la actividad física. Lappset. https://www.lappset.com/es-ES/productos/soluciones/instalaciones-deportivas
13. Martínez Lozano, I. M. (2011). Libro blanco del envejecimiento activo. Instituto de Mayores y Servicios Sociales (Imserso). https://imserso.es/espacio-mayores/envejecimiento-activo/libro-blanco-del-envejecimiento-activo
14. M. A. (2023). Los dispositivos móviles mejoran la eficacia y adherencia al ejercicio físico: Como tratamiento de salud y en comparación con la prescripción presencial. CMD Sport. https://www.cmdsport.com/fitness/actualidad-fitness/los-dispositivos-moviles-mejoran-la-eficacia-adherencia-al-ejercicio-fisico/

15. Murtagh, E. M., Murphy, M. H., Milton, K., Roberts, N. W., O'Gorman, C. S., & Foster, C. (2020). Interventions outside the workplace for reducing sedentary behaviour in adults under 60 years of age. The Cochrane database of systematic reviews, 7(7), CD012554. https://doi.org/10.1002/14651858.CD012554.pub2
16. Navarro, I. (2023). Las apps de eHealth aumentan la adherencia al ejercicio físico en el 70% de los casos. The Objective. https://theobjective.com/tecnologia/2023-03-20/apps-ehealth
17. Neil-Sztramko, S. E., Caldwell, H., & Dobbins, M. (2021). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. The Cochrane database of systematic reviews, 9(9), CD007651. https://doi.org/10.1002/14651858.CD007651.pub3
18. Perez Córdoba, E., Contreras, O., & Campoy, P. (2022). Adherencia al ejercicio físico y mejora en parámetros físicos y psicológicos en una persona mayor: Análisis de caso. Informació Psicològica, 105-116. https://doi.org/10.14635/ipsi.1946
19. Porath, J., Schmidt, L. I., Möckel, J., Dold, C., Hennerkes, L., & Haussmann, A. (2024). What it takes to reduce sitting at work: A pilot study on the effectiveness and correlates of a multicomponent intervention. International archives of occupational and environmental health, 97(1), 9–21. https://doi.org/10.1007/s00420-023-02020-4
20. Redacción Sport Life. (2023). La tecnología nos ayuda a mantenernos en forma: Un estudio de la UOC estudia cómo la tecnología mejora la eficacia y la adherencia al ejercicio físico. Sport Life. https://www.sportlife.es/noticias/tecnologia-nos-ayuda-mantenernos-en-forma_273809_102.html
21. Rehand. (n.d.). 14 claves que debes conocer para promover la adherencia al ejercicio terapéutico. Rehand. https://rehand.net/es/14-claves-que-debes-conocer-para-promover-la-adherencia-al-ejercicio-terapeutico/
22. Serrano-Sánchez, J. A., & Sanchís-Moysi, J. (2023). El uso de instalaciones deportivas para promover la actividad física: Una perspectiva de salud pública y equidad. Nutrición Hospitalaria, 40(3), 605-616. https://doi.org/10.20960/nh.04350
23. Shrestha, N., Kukkonen-Harjula, K. T., Verbeek, J. H., Ijaz, S., Hermans, V., & Pedisic, Z. (2018). Workplace interventions for reducing sitting at work. The Cochrane database of systematic reviews, 6(6), CD010912. https://doi.org/10.1002/14651858.CD010912.pub4
24. Wu, P. Y., Huang, K. S., Chen, K. M., Chou, C. P., & Tu, Y. K. (2021). Exercise, nutrition, and combined exercise and nutrition in older adults with sarcopenia: A systematic review and network meta-analysis. Maturitas, 145, 38–48. https://doi.org/10.1016/j.maturitas.2020.12.009
25. (10Mets, 2022). Cómo mejorar la adherencia al ejercicio terapéutico. 10Mets. https://10mets.com/como-mejorar-la-adherencia-al-ejercicio-terapeutico
26. (Mobipark, n.d.). Gimnasio exterior y vida sostenible. Mobipark. https://mobipark.com/gimnasio-exterior-y-vida-sostenible/

9.5 BIBLIOGRAPHY CH. 5: SELECTED CASE STUDIES

Sweden

1. Andersen, P., Holmberg, S., Lendahls, L., Nilsen, P., & Kristenson, M. (2018). Physical activity on prescription with counsellor support: A 4-year registry-based study in routine health care in Sweden. Healthcare, 6(2), 34. https://doi.org/10.3390/healthcare6020034
2. OECD. (2022). Healthy eating and active lifestyles: Best practices in public health. OECD Publishing. https://doi.org/10.1787/40f65568-en
3. EUPAP. (n.d.). EU-funded "European Physical Activity on Prescription Model" project (EUPAP): Partners. European Physical Activity on Prescription Model. Retrieved from https://www.eupap.org/partners
4. EUPAP. (n.d.). EUPAP feasibility study: Final report. Retrieved from ResearchGate. https://doi.org/10.3390/healthcare6020034

China

1. Shandong Ningtai Body Building Apparatus Limited Company. (2024). National fitness programme. Shandong Ningtai Body Building Apparatus Limited Company. https://www.fitness-china.com/national-fitness-program
2. Government of China. (n.d.). Website identification and copyright notice. Retrieved August 23, 2024. https://www.gov.cn/zhengce/content/2021-08/03/content_5629218.htm
3. Dezan Shira & Associates. (2024). How China's policies are encouraging the growth of the fitness services industry. China Briefing. https://www.china-briefing.com/doing-business-guide
4. Global Times. (2022). Chinese lawmakers revise the law to promote development of sports. https://www.globaltimes.cn/page/202206/1269089.shtml

Finland

1. JAMK University of Applied Sciences. (n.d.). Finland's report card: Physical activity for children and youth. Retrieved from https://www.jamk.fi/en/project/finlands-report-card-physical-activity-for-children-and-youth
2. Global Education Park Finland. (2017). Free health care services and other wellness initiatives. https://www.globaleducationparkfinland.fi/future-skills/wellbeing-at-school
3. Liikkuva Koulu. (2024). Schools on the move. https://liikkuvakoulu.fi/en/home/
4. Blom, A., Tammelin, T., Laine, K., & Tolonen, H. (2018). Bright spots, physical activity investments that work: The Finnish Schools on the Move programme. British Journal of Sports Medicine, 52(13), 820-821. https://doi.org/10.1136/bjsports-2017-097711

Colombia

1. Cultura, Recreación y Deporte. (2015). Política Pública de Deporte, Recreación, Actividad Física, Parques y Escenarios: Decreto 229 de 2015. Secretaría Distrital de Planeación. https://www.sdp.gov.co/gestion-socioeconomica
2. Instituto Distrital de Recreación y Deporte. (2022). Actualización Plan de Acción de la "Política Pública de Deporte, Recreación, Actividad Física, Parques y Escenarios 2022-2032". Secretaría Distrital de Planeación. https://www.sdp.gov.co/sites/default/files/doc_conpes_actualizacion_plan_accion_pp_drafe.pdf
3. Instituto Distrital de Recreación y Deporte. (n.d.). Gimnasios al Parque. Retrieved from https://www.idrd.gov.co/recreacion/bogota-en-forma

South Africa

1. Gore, A., Harmer, P., Pfitzer, M. W., & Jais, N. (2017, June 23). Can insurance companies incentivise their customers to be healthier? Harvard Business Review. https://hbr.org/2017/06/can-insurance-companies-incentivize-their-customers-to-be-healthier

2. Wanni Arachchige Dona, S., Angeles, M. R., Hall, N., Watts, J. J., Peeters, A., & Hensher, M. (2021). Impacts of chronic disease prevention programmes implemented by private health insurers: A systematic review. BMC Health Services Research, 21(1), 1222. https://doi.org/10.1186/s12913-021-07212-7

Johnson & Johnson (J&J)

1. Johnson & Johnson. (n.d.). Workplace mental health—Johnson & Johnson. https://www.workplacementalhealth.org/Case-Studies/Johnson-Johnson#section_1

2. Goetzel, R., Ozminkowski, R., Bruno, J., Rutter, K., Isaac, F., & Wang, S. (2002). The long-term impact of Johnson & Johnson's health & wellness programme on employee health risks. Journal of Occupational and Environmental Medicine, 44(5), 417-424. https://doi.org/10.1097/00043764-200205000-00010

Apps and IoT

1. Kao, Y. S., Nawata, K., & Huang, C. Y. (2019). An exploration and confirmation of the factors influencing adoption of IoT-based wearable fitness trackers. International Journal of Environmental Research and Public Health, 16(18), 3227. https://doi.org/10.3390/ijerph16183227

2. Grech, E. M., Briguglio, M., & Said, E. (2024). A field experiment on gamification of physical activity – Effects on motivation and steps. International Journal of Human-Computer Studies, 184, 103205. https://doi.org/10.1016/j.ijhcs.2023.103205
3. Hu, X., & Li, J. (2024). Research on the integrated solution of physical education based on smart campus. Advances in Physiology Education. https://doi.org/10.1152/advan.00006.2024

9.6 BIBLIOGRAPHY CH. 6: RECOMMENDATIONS

1. Mitchell, M. S., Orstad, S. L., Biswas, A., et al. (2020). Financial incentives for physical activity in adults: Systematic review and meta-analysis. British Journal of Sports Medicine, 54(20), 1259-1268. https://doi.org/10.1136/bjsports-2019-101231
2. O'Regan, A., Pollock, M., D'Sa, S., & Niranjan, V. (2021). ABC of prescribing exercise as medicine: a narrative review of the experiences of general practitioners and patients. BMJ open sport & exercise medicine, 7(2), e001050. https://doi.org/10.1136/bmjsem-2021-001050

9.7 BIBLIOGRAPHY CH. 7: MOTIVATE FURTHER RESEARCH

1. Kubis, H., et al. (2024). Wellbeing and adherence to physical activity: What are the factors of the wellbeing concept leading to exercise adherence? Frontiers. https://www.frontiersin.org/research-topics/28545/wellbeing-and-adherence-to-physical-activity-what-are-the-factors-of-the-wellbeing-concept-leading-to-exercise-adherence/authors
2. Tutu Wang a, Ismail Laher b, Shunchang Li. (2024). Exercise snacks and physical fitness in sedentary populations. Sports Medicine and Health Science. https://www.sciencedirect.com/science/article/pii/S2666337624000283

ABOUT EMEA

EMEA is an independent research institution and forum of debate that provides innovative, forward-looking thinking and political, socio-economic, and financial integrated analyses on Europe, the Mediterranean and Africa in an emerging multipolar world. As a "think and act tank", it strives to contribute decisively to the transition process in the Mediterranean and Africa amidst climatic challenges, unprecedented global financial and economic crises, and geopolitical uncertainties and conflicts.

EMEA was founded in 2012 and has its Headquarters in Barcelona at the Recinte Modernist of Sant Pau – UNESCO World Heritage of Modern Art.

EMEA has a large network of economists, high-level experts and institutional partners (research institutes, think tanks and universities) in the Europe, Mediterranean and Africa.

In 2020 EMEA co-founded the Brain Capital Alliance, and in 2024 the Brain Economy Hub. One of the flagship projects is the Global Brain Capital Dashboard - https://research.euromed-economists.org/brain-capital-dashboard/

The **Brain Capital Alliance** following on from the success of the OECD Neuroscience-inspired Policy Initiative (NIPI), the Brain Capital Alliance is an expanded, multi-national and multi-organisational programme. The programme focuses on neuroscience-inspired investment and public policy innovation as the two most powerful levers for change. It brings together radically diverse stakeholders spanning fields from brain science to policy, economics and finance.

The Alliance brings together world-class contributors from various backgrounds to explore approaches to building Brain Capital at societal scale - https://braincapital-platform.net/

The Brain Economy Hub follows on from the success of the OECD Neuroscience-inspired Policy Initiative (NIPI) and the Brain Capital Alliance. This programme has coined and is leading the brain economy, also known as the brain-positive economic transformation, to move humanity from a brain-unhealthy or brain-negative state to a brain-healthy or brain-positive one. The brain economy must galvanize public, private, and philanthropic actors working across sectors and the world - https://www.braineconomyhub.com/

EURO-MEDITERRANEAN ECONOMISTS ASSOCIATION

Brain Capital Alliance

Brain Economy Hub