

# PHYSICAL ACTIVITY PROMOTION AND DIGITAL INTERVENTIONS

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## ABSTRACT

There is countless evidence regarding the connection between levels of physical activity and obesity as an ongoing global pandemic. Likewise, as the body of evidence has grown, so has the need to take urgent action in finding potential solutions to increase physical activity levels. However, despite the clear benefits of physical activity and evidence associated to digital interventions' success, interventions approached so far have not been enough to pinpoint self-reported barriers to physical activity and tackle the issue successfully. This paper presents a literature review on the fundamental terminology, importance, and the current worldwide panorama of physical activity. In addition, reported barriers to physical activity and digital interventions to overcome barriers and promote physical activity are also reviewed.

## KEYWORDS

Physical Activity, Health Communities, Online Communities, Digital Platforms

## 1. INTRODUCTION

According to Michie et al. (2017a), digital interventions are tools and programs based on digital technology that encourage or support behavioural change using smartphone apps, websites, social networks, text messages, or personal digital assistants. (Rose et al., 2018). These could be helpful in removing obstacles and promoting PA, particularly when taking into account the social support qualities and group-wide possibilities of digital interventions to promote PA (Manzoor et al., 2016; Zeng et al., 2018).

Although there is less proof of the effectiveness of solely digital interventions to promote a healthy diet, physical exercise, or weight control than there is for face-to-face interventions, evidence shows that proactive messaging (i.e., reminders to participate in behaviour change activities, feedback on progress, or advice) results in successful interventions (Rhodes et al., 2020). This suggests that interactivity may increase participation and increase effectiveness.

## 2. BRANCHES IN PHYSICAL ACTIVITY

The World Health Organization (WHO) describes PA as “any bodily movement produced by skeletal muscles that requires energy expenditure” (World Health Organization, 2020). Literature references different types of PA, such as aerobic and anaerobic PA, bone-strengthening activity, exercise, or fitness (Boratto et al., 2017; Guthold et al., 2018; Wu et al., 2015; Zeng et al., 2018). However, although these terms are frequently used interchangeably, there are individual differences among them.

Aerobic PA is movement in which the major muscles of the body move in a repetitive pattern over an extended length of time (World Health Organization, 2020). Aerobic exercise, often known as endurance exercise, promotes cardiorespiratory fitness. Walking, running, swimming, and biking are among examples of aerobic PA. Anaerobic PA, on the other hand, is referred to as short, intense bursts of movement, such as sprinting and weightlifting, where the demand for oxygen exceeds its supply (World Health Organization, 2020). Moreover, bone-strengthening activity is PA with the main goal of strengthening specific regions of the

skeletal system, through force that impacts or exerts tension on the bones during exercises that encourage bone growth and vigour (World Health Organization, 2020). Activities that build bone strength include running, jumping rope, and lifting weights.

Exercise is a subcategory of PA where the goal is to maintain or enhance one or more aspects of physical fitness in an organized, timed, repeated, and intentional manner during leisure time. Whereas fitness encompasses physical and cardiorespiratory health and measures the body's capacity to operate effectively and efficiently in both work and leisure activities (World Health Organization, 2020).

Unlike work-domain PA, which occurs during paid or voluntary work, leisure-domain PA is conducted by a person at their convenience, as a non-necessary part of their daily life. Leisure-domain PA can include participation in sports, physical preparation for sports, and recreation activities like dancing, gardening, and strolling. The WHO (2020) also describes transport-domain PA, which includes walking, cycling, wheeling (the use of non-motorized wheels-equipped means of locomotion), and other similar activities performed with the intention of getting to and from places. The last type of PA is household-domain PA, which includes tasks carried out as part of daily domestic duties.

### 3. PHYSICAL ACTIVITY MATTERS

Despite evidence emphasising that PA is the cornerstone of a healthy lifestyle, global levels of PA have not been improving. Evidence has shown PA to be associated with lower rates of all-cause mortality obesity (Zhao et al., 2020), chronic diseases, such as cardiovascular diseases and hypertension (Carnethon, 2009; Hegde and Solomon, 2017; Lanier et al., 2016; O'Donovan et al., 2017), type-2 diabetes (Hamasaki, 2016), cancer (Brown, Justin C.; Kerri Winters-Stone; Augustine lee; Schmitz, 2014), mental health problems (Biddle, 2016, 1992), and better cognitive health and sleep (Swirski et al., 2019).

A physiological metric used to quantify the intensity of physical activities is the metabolic equivalent of task (MET), or simply, metabolic equivalent— which is the amount of energy a person expends while sitting still and at rest, expressed in METs (World Health Organization, 2020). The WHO (World Health Organization, 2020) uses METs to classify PA intensity into three main categories: vigorous, moderate, and light.

Vigorous-intensity PA refers to PA at 6.0 or greater METS and is usually rated a 7 or 8 on a scale of 0–10 relative to an individual's personal capacity. Moderate-intensity PA is defined as any exercise that is between three and six times as intense as rest. Moderate-intensity PA is typically rated a 5 or 6 on a scale of 0–10, depending on the person. Light PA is defined as consuming 1.5 to 3 METs, or less than three times the amount of energy used when that individual is at rest. This can involve easy movement, taking a shower, or other incidental activities that do not significantly raise heart rate or breathing rate.

However, some authors believe that time spent in sedentary behaviour is strongly and negatively associated with cardiometabolic health, cardiovascular disease, conditions such as type 2 diabetes, osteoporosis, and some cancers. This is why they make it a more significant indicator of poor health than moderate or vigorous PA (Gordon-Larsen et al., 2004; Owen et al., 2010; Thorp et al., 2011; World Health Organization, 2020).

The WHO Handbook for Guideline Development use the term "sedentary behaviour" to designate self-reported low movement sitting (during leisure, employment, and total time), television viewing, screen time, and low levels of movement as measured by equipment that measure movement or posture. Sedentary activities include those performed by those unable to stand—such as wheelchair users, most desk-based office work, operating a vehicle, and watching television.

Although sedentary behaviour is commonly used to refer to physical inactivity, it is not the same. Popularly, and from a one-dimensional standpoint, sedentary behaviour has been used to describe conducts “marked by much sitting” (Agnes, 2002). On a more complex perspective, the WHO Handbook for Guideline Development refers to physical inactivity as “an insufficient PA level to meet present PA recommendations” which refers to “any waking behaviour characterized by an energy expenditure of 1.5 METS or lower while sitting, reclining, or lying” (World Health Organization, 2020).

Some authors believe that although the suggested 1.5 MET threshold for sedentary behaviours seems reasonable, some sitting based activities may be classified as non-sedentary and on that account, further research is needed (Mansoubi et al., 2015). Moreover, the WHO reports that to help lessen the negative impact

of excessive levels of sedentary behaviour on health, adults should strive to engage in more than the advised amounts of moderate-to-vigorous intensity PA (World Health Organization, 2020).

Obesity is a condition in which abnormal or excessive fat has accumulated to the extent that health may be impaired (World Health Organization, 2000). This condition is often related to sedentary behaviour because it is believed to be an important contributor to the growth in population average body weight (Aubert et al., 2021; Cabrera de León et al., 2007; Thorp et al., 2011; Vasques et al., 2012).

Besides being a chronic disease, obesity is an epidemic, frequently characterized as a potential health-impairing condition that comprises the accumulation of abnormal or excessive fat in the adipose tissue (World Health Organization, 2020). The World Health Organization (2000) recognizes that overweight and obesity are associated to some major health consequences, such as: NIDDM, CHD, hypertension, gallbladder disease, psychosocial problems, and certain types of cancer.

Over the past few decades, literature has defined the average PA recommendation time in a wide range of capacities. Cabrera de León et al. (2007) considered that an individual who engages in a PA daily average duration of 25-30 minutes can still be considered a sedentary person. Subsequently, the “Active Couch Potato” phenomenon, introduced a decade ago, explored the possibility of labelling individuals who engage in moderate-to-vigorous PA yet still have high sedentary behaviour time as sedentary individuals (Mansoubi et al., 2015; Owen et al., 2010).

The most recent PA and sedentary behaviour guidelines from the WHO report specific global PA recommendations complemented by reassuring evidence (World Health Organization, 2020). Children and adolescents (5-17 years old) should engage in at least an average of 60 minutes per day of aerobic PA of moderate to vigorous intensity over the course of the week. Of the recommended exercise period, at least three days a week should be dedicated to high-intensity aerobic exercise as well as activities that develop bone and muscle (Aubert et al., 2021).

Furthermore, for significant health advantages, adults (18-65 years old) should engage in at least 150–300 minutes of moderate–intensity aerobic activity, at least 75–150 minutes of vigorous–intensity aerobic activity, or an equivalent combination of moderate– and vigorous–intensity activity throughout the week. For additional health benefits, adults should also engage in muscle-strengthening exercises that use all the major muscle groups twice a week or more, at a moderate to high intensity (Watson et al., 2021; World Health Organization, 2020). As for older adults (65 years old and older), for significant health advantages, they should engage in at least 150–300 minutes of moderate–intensity aerobic PA, at least 75–150 minutes of vigorous–intensity aerobic physical exercise, or an equivalent combination of both during the week (World Health Organization, 2020).

#### **4. OVERLOOKING PORTUGAL AND THE WORLD**

The relationship strength between PA during the early stages of life and adulthood can predict PA’s progression from youth to adulthood (Gordon-Larsen et al., 2004; Malina, 2001; Tamellin, 2003). Heredity is associated with PA, fitness, and health—the three main components of a relationship model designed by Bouchard, Shepard and Stephens (1994). Parent education, scholastic achievements, level of PA during childhood and adolescence are also among some of the factors that seem to be directly correlated with engaging in PA during adulthood (Tamellin, 2003).

Between adolescence and young adulthood there is a considerable decline in PA and stability of sedentary behaviour (Gordon-Larsen et al., 2004; Hayes et al., 2019). In view of that, the probability of becoming either overweight, or obese, increases with age. Accordingly, maintaining high levels of PA across the lifespan is an important challenge for public health promotion, especially since it is easier to maintain PA throughout adulthood with an active childhood than attempting to make major lifestyle changes in the future (Tamellin, 2003).

In longitudinal studies, significant rise in BMI, mean weight and body fat have been detected in higher education students. Pope, Hansen, and Harvey (2016) found that mean weight was higher at the end of their senior year than in the beginning of their freshman year, as students continuously gained weight over the course of the four years. In another four-year longitudinal study, Gropper et al. (2012) also noticed an increase in college students’ weight, in overweight or obesity from 18% to 31%. This advocates that first-year bachelor’s degree students are a population of concern for overweight and obesity, therefore a favourable research sample

to examine throughout higher education experience. For this reason, Pope et al. (2016) believes that to combat the rising rates of overweight and obesity, college students should be a prevalent target-population.

Insufficient PA was prevalent globally among the 1.9 million people who self-reported their PA levels through the International Physical Activity Questionnaire in 2016, with a frequency of 27.5% compared to 28.5% in 2001 (Guthold et al., 2018). The burden of several chronic diseases and early mortality has been increased by 6% to 10% globally due to the high prevalence of physical inactivity (Ozemek et al., 2019). Additionally, the percentage of people that meet the WHO's Guidelines on PA recommendations varies across different age groups (Huber et al., 2020; Watson et al., 2021; Wilke et al., 2021). Correspondingly, approximately 81% of adolescents aged 11 to 17 years old and 28% of adults aged 18 years old and over are insufficiently physically active (Cardon and Salmon, 2020; Guthold et al., 2018).

In Portugal, over the last two decades (1995-1998 to 2003-2005), overweight and obesity prevalence has increased. Likewise, studies have found that more than half of the Portuguese adult population has unhealthy weight, with 54% of population from 18-64 years old being overweight, 14% obese and 30% of population from 10-18 years old overweight and 8% obese (Bordalo et al., 2015; Do Carmo et al., 2006; Ferreira, 2010).

In 2010, there was 30.4% overweight prevalence in adolescent Portuguese population (22.6% pre-obese and 7.8% obese) and, as projected, adolescents with a healthy weight had higher levels of PA (Ferreira, 2010). Also, in 2013, the central region of Portugal held the highest prevalence of overweight population (38.0%) (Rito and Graça, 2015). Likewise, Rito et al. (2015) found that the central region of Portugal presented the uppermost incidence of underweight (5.0%) and overweight (38.0%) individuals, as well as child obesity (17.8%).

The National Food, Nutrition and Physical Activity Survey (Lopes et al., 2017) reported that 43% of the Portuguese population over 14 years old are sedentary, considering that they do not meet any of the WHO Guidelines on PA. Moreover, only 36% of youth (15-21 years old), 27% of adults and 22% of the elderly (65-84 years old) are physically active, fulfilling the official Physical Activity Engagement for Health recommendations (Lopes et al., 2017).

Data associated with meeting the WHO Global PA recommendations during and after the COVID-19 pandemic (as of March 2020) must consider the resulting PA changes due to the government-imposed lockdowns, bans of social gatherings, and business closures. Recent literature has found that PA has significantly decreased since the COVID-19 pandemic, calling it a “pandemic within a pandemic” (Wilke et al., 2021).

According to the 2020 SummerStyles survey, 30.4% adults (18 years old or older) reported being less active, and 42.7% of adults reported no change in their amount of PA during the pandemic (Watson et al., 2021). Likewise, in Germany, 45% of young adults reported being less active during the pandemic, whereas 33% reported being more active (Huber et al., 2020).

In another study, compared to pre-restrictions self-reported PA, overall self-reported moderate-to-vigorous PA declined by 41% and vigorous PA declined by 42.2% (Wilke et al., 2021). Moreover, one study found that only one in five children met the WHO Global PA recommendations and that around 70% of participants used more screen time in weekdays than the advised 2 hours per day (Kovacs et al., 2021).

Consequently, the causes of variations in adults' levels of PA between studies, which are either higher or lower than recommended levels, are unknown. Knowing which subgroups were more active could assist and inform on the development of population-level tactics that may be applied to different groups or in non-pandemic situations (Hayes et al., 2019; Watson et al., 2021; Wilke et al., 2021). All things considered, these numbers suggest that more needs to be done, particularly in the younger groups, such as exploring new strategies and resources, to promote PA (Kovacs et al., 2021; Ozemek et al., 2019; World Health Organization, 2020).

## **5. REPORTED BARRIERS AND IMPEDIMENTS**

Besides exploring the specificity of recommended intensity levels in PA, it is important to understand the underlying reasons for not meeting these criteria. Literature has identified a few multi-factorial categories for PA barriers: individual, psychological and environmental (Bantham et al., 2021; Daskapan et al., 2006).

In adolescence, individual and environmental barriers are among the most cited barriers (Bantham et al., 2021; Daskapan et al., 2006). Among them are factors such as lack of time due to busy lesson schedule or

responsibilities related to the family and social setting, academic success priority over exercise, or lack of energy to do exercise. Whereas in adults, psychological barriers are, according to evidence, the biggest barriers that prevent adults from considering and engaging in PA (Bantham et al., 2021). All in all, although some authors believe that the importance of reported external barriers might outweigh that of perceived interior obstacles (Daskapan et al., 2006), recent literature reports otherwise (Bantham et al., 2021; Hamer et al., 2021; Toscos et al., 2010).

Illness or injury, and actual or anticipated body changes are among naturally occurring barriers reported by individuals considered under-represented by literature (Toscos et al., 2010). Overindulgence on PA has been associated with various illnesses and injuries, resulting in muscle soreness, difficulty getting back on track after illness (e.g., cold or flu), and inability to restart PA after a break (i.e., “falling off the wagon”). Actual or anticipated body changes, refers to complaints related to bulking up on the lower body or upper body, or losing weight in the “wrong” places due to PA.

Furthermore, several preliminary studies have shown that among middle-aged to older persons, greater levels of fear are linked to decreased activity levels (Hamer et al., 2021). This has resulted in the conceptualization of several fear types, including fears of experiencing pain, pain-related fears, fears of movement, fears of falling or injury, fears of cardiac events, fears of joint damage, fear of embarrassment, fears of enacted stigma, fear of harm, and fears of integrating community due to crime (Bantham et al., 2021; Daskapan et al., 2006; Hamer et al., 2021; Toscos et al., 2010).

Studies on fear among different age groups also vary. In other words, fears of injury, enacted stigma, and embarrassment have been observed across a range of age groups (Hamer et al., 2021). However, in younger age groups, the fears of pain, movement, and falling have rarely been reported.

Moreover, environmental barriers include but are not limited to having accessibility to safe spaces, healthcare inclusion and health conditions, financial constraints, social and cultural norms, family relationships (e.g., being married or having kids at home), work responsibilities, health and physical literacy levels, and/or access to information/educational resources. Access to safety-conscious places (i.e., recreational facilities, public parks) regard places areas that are risk-free, cool in the summer or warm in the winter, conveniently located near residences or places of employment, and inexpensive at no cost or cheap cost (Bantham et al., 2021).

Among the most frequent concerns are general safety, verbal abuse, gang-related activity, physical harm or assault, and gun violence (Andrade et al., 2018; Bantham et al., 2021; Toscos et al., 2010). Chronic health conditions have frequently been reported as challenges that prevent or make it difficult for individuals to be physically active, thus many individuals have identified that their current physical condition is a barrier for being unable to exercise (Hamer et al., 2021; Toscos et al., 2010).

The absence of informational and educational resources and lack of cultural considerations have also been linked to a higher risk of inactivity, according to observational research (Bantham et al., 2021; Sebastião et al., 2015). Some people believe they obtain enough PA from their daily activities because they are unaware of how much PA they should be performing to improve their health. This may be often brought on by an inadequate of knowledge availability, linguistic constraints, or trouble understanding offered information due to highly technical language and unfamiliarity with activities described in informational materials (Sebastião et al., 2015). Henceforth, if important cultural, social, political, historical, and economic elements within communities are not considered, the acceptability, viability, and sustainability of PA initiatives are jeopardized.

Without contemplating the role of cultural and societal value, the implementation of interventions may be inaccurate, as it risks being solely based on generalizations about a community or the researchers' own beliefs rather than objectively established, culture-centred hypotheses (Bantham et al., 2021; Sebastião et al., 2015). To overcome these barriers, literature suggests using methods that are linguistically and culturally suitable. Raising awareness is just one of them.

Others include creating PA communities, engaging in community-based participatory research, and forming interdisciplinary research teams (Bantham et al., 2021). In fact, addressing inequality in access to safe, inclusive, accessible, inexpensive, and suitable locations is a guiding principle of the WHO's Global Action Plan on PA for the 2018 to 2030. Therefore, multi-level intervention must be implemented to alleviate PA inequities in both general and marginalised population.

## **6. HOW DIGITAL CAN STAND IN A PHYSICAL DIMENSION**

Digital interventions can be described as digital technology-based tools and initiatives that encourage or promote behavioural change (Michie et al., 2017b) using smartphone applications, websites, social network, text messaging, or personal digital assistants (Rose et al., 2018). Given their social support properties and communal potential to encourage PA, digital interventions may contribute positively to overcoming barriers and increasing PA (Manzoor et al., 2016; Zeng et al., 2018).

Although there is less proof of the effectiveness of solely digital interventions to promote a healthy diet, physical exercise, or weight control than there is for face-to-face interventions, evidence shows that proactive messaging (i.e., reminders to participate in behaviour change activities, feedback on progress, or advice) results in successful interventions (Rhodes et al., 2020). This suggests that interactivity may increase participation and increase effectiveness.

Evidence confirms that the internet may be a useful tool for extending the geographic scope of an initial, offline project and converting it into more pervasive public health practice (Mummery et al., 2006). Furthermore, literature suggests that using social networks rather than a PA monitoring system may encourage and support people in their regular PA (Elloumi et al., 2018; Resnick et al., 2010).

Since digital interventions' effectiveness seems to be dependent on socioeconomic status (Western et al., 2021), research recommends that the development of digital interventions considers literacy levels' inclusiveness (Rhodes et al., 2020). Moreover, majority of people have favourable opinions of most interactive and audio-visual elements' components and functionalities in digital interventions, independently of literacy levels (Rowell et al., 2015).

Certain features, such as interactive individual challenges, are positively associated with increase of user engagement on websites (Davies et al., 2012). And, whereas interactive activity planners are perceived as difficult to complete and have biased responses, website features (i.e., interactive quiz, and tailored feedback), and content (i.e., images and audio-visual sequences) are perceived as pertinent, entertaining, motivating, and helpful (Rowell et al., 2015).

However, notwithstanding the benefits in digital interventions, long-term engagement seems to be a frequently reported problematic. In the beginning, participants see a lot of potential for this type of online practice (García-Monge et al., 2019). Yet, subsequently, there is a decline in user engagement. Reported factors include issues such as lack of time, laziness, increased caution when uploading texts to an online forum, anxiety about being judged, and shyness around other more academically accomplished users who participate in discussion boards (Davies et al., 2012; García-Monge et al., 2019; Tague et al., 2014).

Essentially, using digital interventions could be a way to promote PA more dynamically and targeting a wider audience at reduced costs (Rhodes et al., 2020; Rose et al., 2018). This ought to be particularly applicable if initiatives prioritize adaptability in literacy levels and accessibility of resources (Bantham et al., 2021; Sebastião et al., 2015; Western et al., 2021). Nonetheless, despite the potential benefits of employing digital interventions to promote PA, several obstacles must be overcome (Malinen & Nurkka, 2015; Sanders et al., 2019). One of the most critical ones being: the long-term maintenance of user engagement (Tague et al., 2014, Toscos et al., 2010).

## **7. ONLINE COMMUNITIES TO ENCOURAGE PHYSICAL ACTIVITY**

It is undeniable that the public continues to struggle with satisfying WHO guidelines for healthy lifestyles in terms of PA (World Health Organization, 2020; Zhao et al., 2020). Similarly, we found in this study that OC has not been effectively employed in increasing PA. In reality, the current dynamics haven't been strong enough to continuously promote PA in a way that encourages long-term adoption of more desirable PA levels.

The combination of social relationships' pertinence and the undeniably significant component of efficient communication in DP in the modern world in online communities (Groenewegen et al., 2012; Resnick et al., 2010) and its significance within the context of science (Popp and Woratschek, 2016; Vandelanotte et al., 2019) provide a strong case for future PA interventions. This may present a chance for more effective PA promotion in online forums in an effort to lessen a currently recognized public health issue (Bordalo et al., 2015; Camões and Lopes, 2008; Do Carmo et al., 2008; Lopes et al., 2017).

Accordingly, it would be extremely helpful to undertake studies in online communities connected to PA digital interventions, to comprehend how they can serve as a tool to promote behaviours, and to discover characteristics that may affect long-term user participation in online communities. Particularly, discussions in online communities with the aim of promoting PA, to prevent lifestyles leading to in sedentarism and obesity (Gordon-Larsen et al., 2004; Zhao et al., 2020) and, subsequently, chronic diseases that significantly reduce quality of life and overall life expectancy (Biddle, 2016; World Health Organization, 2020).

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