Centro Universitário de Lisboa
Faculdade de Educação Física e Desporto - FEFD
Doutoramento em Educação Física e Desporto

Does context matter?
Domains of physical activity and sedentary behavior and their relations with well-being and health-related quality of life in adults

Tese defendida em provas públicas para a obtenção do grau de Doutor em Educação Física e Desporto, na especialidade de atividade física e saúde, orientada pelo Professor Doutor Pedro B. Júdice

Sabrina Costa Teno

2024

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"Versão final"

Tese defendida em provas públicas na Universidade Lusófona, Centro Universitário de Lisboa, no dia 25 de novembro de 2024, perante o júri, nomeado pelo despacho de nomeação nº 918/2024 de 29 de julho de 2024, com a seguinte composição:

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Este trabalho também foi orientado pela Professora Doutora Marlene N. Silva, Professora Associada da FEFD – Universidade Lusófona.

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Epígrafe

O começo de todas as ciências é o espanto de
as coisas serem o que são.

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Resumo

As recomendações públicas para atividade física (AF) incidem no volume e na intensidade para benefícios na saúde física e mental, assim como na redução do comportamento sedentário (CS). No entanto, ambos os comportamentos podem ser acumulados em diversos contextos (domínios) da vida, como no trabalho, no lazer e nos transportes, e ainda não está claro na literatura, qual a relação entre a AF e o CS acumulados em diversos domínios com o bem-estar e a qualidade de vida. Esta tese procurou, através de uma revisão sistemática, três investigações observacionais e uma experimental, esclarecer estas lacunas, analisando ainda se estas relações poderiam ser distintas entre géneros e idades.

A revisão sistemática indicou que quando se trata de bem-estar e qualidade de vida, a AF de lazer foi a que apresentou as associações positivas mais consistentes com diversos indicadores de bem-estar, assim como negativas com indicadores de doenças/transtornos mentais. Por outro lado, o CS no trabalho e no lazer foram os mais prejudiciais. Posteriormente, foram analisados dados de investigações observacionais, tendo sido encontrados como principais correlatos negativos para a satisfação com a vida (um dos principais indicadores de bem-estar subjetivo) o CS no trabalho, a perceção financeira baixa e a atividade física no transporte ou no trabalho (AF incidental), resultados em linha com as conclusões da revisão sistemática.

Para tentar explorar se os domínios da AF estavam associados a outros indicadores de saúde, foi realizada uma segunda investigação observacional, tendo os seus resultados denotado que em adultos, ser fisicamente ativo através da AF de lazer confere benefícios adicionais à saúde, comparado a ser ativo durante a AF incidental. Estes resultados pareceram ser diferentes entre géneros, indicando que os papéis sociais podem assumir um efeito moderador em alguns benefícios. Uma vez que os domínios do CS têm sido menos explorados na literatura, foi também realizada uma investigação para identificar as relações deste tipo de comportamento nos diversos domínios com indicadores de bem-estar e qualidade de vida. Os resultados evidenciam que para adultos acima dos 25 anos, o CS no trabalho apresentou relações negativas, no entanto, para adultos mais jovens (18–24 anos), acumular tempo sentado durante o tempo de lazer pareceu ser mais prejudicial.

Por fim, dados de uma investigação experimental indicaram que os adultos com trabalhos predominantemente sedentários, e que conseguiram reduzir o tempo sentado, foram também aqueles que alcançaram melhores resultados nas avaliações de bem-estar e qualidade de vida após 6 meses. No entanto, quando comparados com aqueles que não reduziram o tempo

sentado, esta diferença não foi significativa. Tomados no seu conjunto os resultados desta tese indicam que para além do volume e intensidade, as recomendações de saúde sejam precisas em termos contextuais, indicando também o domínio como um facilitador de bem-estar e qualidade de vida. Além disso, com recomendações mais específicas será possível evitar a mensagem de que as pessoas que apenas conseguem cumprir o mínimo recomendado em domínios não relacionados ao lazer, obterão os mesmos benefícios que aqueles que realizam atividade física de lazer, reduzindo as desigualdades perpetuadas.

Abstract

Public recommendations for physical activity (PA) focus on volume and intensity to benefit physical and mental health, as well as on the reduction of sedentary behavior (SB). However, both behaviors can be accumulated in different contexts (domains) of life, such as work, leisure, and transport, and it is still not clear in the literature what is the relationship for PA and SB accumulated in different domains with the well-being and quality of life. This thesis sought, through a systematic review, three observational and one experimental investigation, to clarify these gaps, while verifying whether these relationships could be distinct between sexes and age groups.

The systematic review indicated that when it comes to well-being and quality of life, leisure-time PA presented the most consistent positive associations with various well-being indicators, as well as negative associations with indicators of mental illnesses/disorders. On the other hand, SB at work and leisure-time were the most harmful. Subsequently, we explored data from one of our observational investigations and found that SB at work, low financial perception, and PA for transport or at work (incidental PA) were the main negative correlates for life satisfaction (one of the main indicators of subjective well-being), which was in line with the findings from the systematic review.

To discover whether the PA domains were associated with other health indicators, we also carried out a second observational investigation and found that in adults, being physically active during leisure-time confers additional health benefits compared to being active in incidental PA. These results appeared to differ between genders, indicating that social roles may have a moderating effect on some benefits. Since the domains of SB have been less explored in the literature, we carried out an investigation to identify the relationship of this type of behavior with indicators of well-being and quality of life. We found that for adults over 25 years old, SB at work showed negative relationships, however, for younger adults (18–24 years old), accumulating sitting time during leisure-time seemed to be more harmful.

Finally, our experimental research indicated that adults with predominantly sedentary jobs, and who managed to reduce sitting time, were also those who achieved better results in well-being and quality of life assessments after six months. However, when compared to those who did not reduce sitting time, this difference was not significant. Therefore, we recommend that in addition to volume and intensity, health recommendations must be precise, while indicating the domain as a facilitator of well-being and quality of life. Furthermore, with more

specific recommendations, it will be possible to avoid the message that people who can only meet the recommended minimum in non-leisure-related domains will obtain the same benefits as those who perform leisure-time physical activity, reducing perpetuated inequalities.

Abbreviations

GLS: General life satisfaction

HRQoL: Health related quality of life

IPA: Incidental physical activity

IPAQ: International physical activity questionnaire

LTPA: Leisure-time physical activity

LS: Life satisfaction

MVPA: Moderate to vigorous physical activity

OECD: Organization for Economic Co-operation and Development

OPA: Occupational physical activity

PA: Physical activity

PWB: Psychological well-being

QoL: Quality of life

SB: Sedentary behavior

ST: Sitting time

SWB: Subjective well-being

TPA: Transport physical activity

WHO: World Health Organization

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Chapter I

General introduction and purpose

Quando o homem compreende a sua
realidade, pode levantar hipóteses sobre o
desafio dessa realidade e procurar soluções.
Assim, pode transformá-la e o seu trabalho
pode criar um mundo próprio, seu Eu e as
suas circunstâncias.

Paulo Freire

Chapter I

1. General introduction and purpose

1.1. The concepts of mental health, well-being, and quality of life

Mental health is defined by the World Health Organization (WHO) as a positive well-being state in which individuals realize their full potential, experience positive emotions, can cope with stress, maintain positive interpersonal relationships, work productively, and contribute to their community (World Health Organization, 2005). It is considered more than the absence of mental disorders, but an integral component of health and well-being that underpins our individual and collective abilities to make decisions, build relationships, and shape the world. It is a basic human right crucial to personal, community, and socio-economic development (OECD, 2023; World Health Organization, 2022). In this thesis, we will consider mental health as a complex continuum, which is experienced differently from one person to the other, with varying degrees of difficulty and distress and potentially different social and clinical outcomes, indicating that the farther a person is from positive mental health, the closer will be to a mental illness (OECD, 2023). Mental health has been assessed both from a positive perspective (e.g., through evaluation of subjective well-being, life satisfaction, affects) and from a negative perspective (e.g., through evaluation risk, incidence or symptoms of depression, anxiety, or psychological distress).

Mental health has been used as synonym of well-being, this concept in turn, comes from social movements inspired by Illuminism and Utilitarianism, which boosted research around quality of life, as well as related to developments in the field of health, specifically, the 2nd Health Revolution, in the 70s. Since then, the central principles were to advocate the return to an ecological perspective in health and to change the focus from disease issues to positive functioning (Galinha & Pais-Ribeiro, 2005). After a few years of research and the discovery of the scope of its identity, as well as divergences between researchers, the concept of well-being has undergone a subdivision between psychological and subjective well-being. Psychological well-being constitutes a field of study, founded in the 80s by Carol D. Ryff and integrates the concepts of self-acceptance, autonomy, control over the environment, positive relationships, purpose in life, and personal development; which would cover the field of the “eudaimonia” (Greek word literally translating to the state or condition of 'good spirit'). On the other hand, subjective well-being, which forms another field of study, integrates the dimensions of affection and satisfaction with life, responding to the field “hedonic” of well-being (refers to the prioritization of pleasure in one's lifestyle, and pain and suffering avoidance) (Galinha & Pais-Ribeiro, 2005; Skevington & Böhnke, 2018). Thus, after some debate around its definition, subjective well-being (SWB) was conceptualized as how a person evaluates his/her life, including life and material satisfaction, absence of depression and anxiety, and presence of positive emotions (Diener, 1984; Diener et al., 1999).

The term quality of life (QoL) had already appeared shortly before, in the 60s, aiming to underline that there is more to the human condition than material well-being, precisely in a post-war period of great economic development (Diener & Seligman, 2004), and that it evaluated the development of nations through indicators that did not accurately reflect the living conditions of populations (e.g., gross domestic product – GDP). Thus, QoL was defined by the WHO as a person's perception of their position in life, in the context and culture and value system in which they live, about their goals, expectations, standards, and concerns (The World Health Organization, 1995). In this context the term Health-related quality of life (HRQoL) was created, that is a subset relating only to the health domain of that existence, and although there are more than one term for this definition, HRQoL include only those aspects that are part of an individual’s health, and do not include, for example economic and political circumstances (Karimi & Brazier, 2016).

1.2. *Importance of well-being and quality of life*

According to the WHO, mental disorders are one of the largest causes of disability worldwide, and it is estimate that 1 in every 8 people around the world were living with a mental disorder in 2019 (WHO 2022), number that increased in 2020 by 26% and 28% for anxiety and depressive disorders respectively, because of the COVID-19 pandemic (WHO, 2022a). It was estimated 418 million disability-adjusted life years (DALYs) could be attributable to mental disorders in 2019 (16% of global DALYs). The value associated with this burden is estimated at 5 trillion USD (Arias et al., 2022), making mental health an important factor in achieving global development goals, and studies focusing on their promotion, an emerging research field. Furthermore, the academic environment is among the most stressful contexts to be in, despite being rewarding, both students and staff suffer with mental health problems, and finding how to improve well-being in this context can contribute to soften future problems (Lipson et al., 2022; Wettstein et al., 2021).

On the other hand, it has been empirically demonstrated that SWB precedes successful situations in various domains of a person's life, including job performance, health, and good relationships (Lyubomirsky et al., 2005). In cross-sectional, longitudinal, and experimental studies, SWB has been associated with self-perceived health, longevity, healthy behaviors (for example, adherence to mediterranean diet and physical activity), mental and physical illnesses (negatively), social connectivity, citizenship, and productivity (Andrade et al., 2020; Buecker et al., 2021; Diener, 2012; Diener et al., 2017; Diener & Chan, 2011; Diener & Seligman, 2004; Lyubomirsky et al., 2005; Neve et al., 2013). Besides that, well-being and happiness have been positively associated with the wide concept of health (i.e., as defined by WHO as a state of physical, mental and social well-being) that is, those with higher scores in life satisfaction and happiness and lower depressive symptoms have fewer chance of chronic disease as diabetes, coronary heart disease (Ni et al., 2020; Rosella et al., 2019), have lower chances of joint pain, visceral and total body fat, hospital admissions, dementia, frequent headache, are more physically active, weekend family activities, family support, communication with family members (Ni et al., 2020), indicating the importance of well-being for individual's QoL and its contribution to public health agenda. Furthermore, in terms of population, well-being is important because it serves as an overall measure of a nation's success in meeting the needs, goals, and values of citizens (Diener & Seligman, 2004).

1.3. Dimensions of subjective well-being and quality of life

SWB is composed of an evaluative/cognitive dimension, in which there is an evaluative judgment, usually expressed in terms of satisfaction with life – in global or specific terms (for example, with work/study/relationship satisfaction). Typically, in its evaluation the questions are formulated as single item self-reports, for example as "All things considered, how satisfied are you with your life as a whole these days?" or with multiple questions where the respondent report their level of agreement with some statements with points scale from "strongly disagree to strongly agree" (Kapteyn et al., 2015). In addition, there is an emotional dimension (affect experienced), feelings positive or negative – also expressed in global terms, or specific terms, (Galinha & Pais-Ribeiro, 2005; Kapteyn et al., 2015). Positive affect refers to the frequency of positive emotions experienced by an individual (emotions such as pride, and interest) while negative affect refers to the frequency of negative emotions (such as sadness, worry, hostility). Thus, people who demonstrate positive well-being experience a preponderance of positive emotions over negative emotions and positively evaluate their life as a whole (McCullough et al., 2000).

There is not a consensus about the number of domains that compose the QoL, but in general, include (Dedhiya & Kong, 1995; Gandek et al., 1998a; The World Health Organization, 1995):

a) Physical domain: it can include, energy, strength, the individual's ability to perform everyday activities, such as going to work, and performing household chores; in addition, feelings that impair the individual's quality of life, such as gastrointestinal pain, nausea, and shortness of breath.
b) Psychological domain: including perceptions about one's own health or psychological parameters, which have an impact on quality of life, such as depression, anxiety, and fear.
c) Social functioning: an individual's ability to carry out the personal interactions that form the core of community life, such as relationships with family members, close friends, and co-workers.
d) Environment: access to information, healthy environment, to health care, security and cleanliness, opportunities for leisure activities, and sometimes.
e) Spirituality/religion/personal beliefs: the person's personal beliefs and how these affect his quality of life. This might be by helping the person cope with difficulties in their life, giving structure to their experience, ascribing meaning to spiritual and personal questions, and more generally providing the person with a sense of well-being.

1.4. Determinants/correlates or predictors of subjective well-being

Correlates, determinants, or predictors of SWB are those that can potentially influence it, thus, understanding them can be important to better explain what contributes to improve people' quality of life/well-being, and better promote public policies and interventions. A recent investigation (Das et al., 2020) identified the main determinants or correlates of SWB and separated them into seven broad categories:

- Basic demographics: gender, age, and race/ethnicity;
- Socioeconomic status: income, education, employment, family structure, and immigration status;
- Health and functioning: general or self-reported health, diseases status, mental and physical disability, obesity, sleep, and physical activity (PA);
- Personality: the Big Five personality traits and nuanced traits, such as self-efficacy, optimism, and self-esteem;
- Social support: the number of contacts, quality of contacts, friends, family, family satisfaction, social satisfaction, and discrimination;
- Religion and culture: formulation of comparison standards, religiosity, and visits to houses of worship (mosque, temple, synagogue, etc.);

- Geography and infrastructure: conditions at various levels of disaggregation, including nation, region, community (city, town, or parish), neighborhood, and home, and access to infrastructures, such as food, water, sanitation, transportation, greenery, leisure, and ecosystems.

2. Summary of the thesis

This thesis will focus on i) the relationships between health and functioning behaviors (3rd point of the prior caption) and subjective well-being, mental health, and HRQoL; ii) deepen the knowledge about the role of PA and sedentary behavior and their distinct domains on well-being and HRQoL.

2.1. Physical activity, sedentary behavior, and their domains

Physical activity (PA) is defined as any voluntary bodily movement produced by skeletal muscles that requires energy expenditure above resting (Caspersen et al., 1985) and its benefits include a lower risk of cardiovascular disease, hypertension, obesity, diabetes, breast cancer, and colon cancer (Pedersen & Saltin 2015), a lower risk of depression (Pearce et al., 2022), and improved QoL and well-being (Marquez et al., 2020). However, the benefits originate from attaining certain levels of PA. The scientific evidence supports the recommendation for adults (18-64 years) of at least 150–300 minutes of moderate-intensity PA (or 75–150 minutes of vigorous-intensity PA) or an equivalent combination throughout the week (Bull et al., 2020). Global surveillance data indicate that in 2016 levels of physical inactivity remained high (27.5%) and stable over the previous 10 years (Guthold et al., 2018). Thus, the WHO has a target for a 15% reduction in the global prevalence of physical inactivity in adults and in adolescents by 2030 (World Health Organization, 2018). Besides that, the WHO recommends the reduction of sedentary behavior to improve health outcomes.

Sedentary behavior (SB) is defined as any activity while awake, with ≤1.5 metabolic equivalents, in a seated or reclining posture (Tremblay et al., 2017a), and excessive accumulation of SB has been associated with all-cause mortality, cardiovascular disease, type II diabetes, abdominal obesity, some types of cancer, and depression (Huang et al., 2020; Júdice et al., 2015; Patterson et al., 2018). Both behaviors (i.e., PA and SB) are related, but are considered independent (Maher et al., 2013), and can be accumulated in the most diverse contexts or domains. PA in the leisure-time (LTPA), is defined as all behaviors related to PA that people perform in their free time (Steinbach & Graf, 2008), in addition to, PA can be performed for commuting, and for domestic or occupational activities (for example, gardening or load objects during work) (Caspersen et al., 1985; Howley, 2001), and both (commuting and occupational) are called of incidental PA (IPA) (any activity that is part of one's daily living that is not done with the purpose of recreation or health) (Care, 2021; Strath et al., 2013; Tremblay et al., 2007). SB can also be performed in the same domains, besides that, it can be accompanied by screen use (for example time spent using screen for leisure in social media, or studying/working [occupational] and commuting [driving or in a public transport]) (Tremblay et al., 2017b).

The positive relations between PA, as the negative relations of SB with several measures of well-being and QoL are established, in adults, adolescents, and even in people with mental disorders (Huang et al., 2020; Li et al., 2024; Marquez et al., 2020; Villafaina et al., 2021). For example, in a systematic review conducted for the 2018 U.S. Health and Human Services Physical Activity Guidelines for Americans Scientific Advisory Committee Report, with data from 2006 to 2018 predominantly from randomized controlled trials, PA improved QoL and well-being for adults when compared with minimal or no-treatment controls (Marquez et al., 2020). Furthermore, in a large meta-analysis with twelve prospective studies involving 128,553 adults participants, a significantly positive association between SB and the risk of depression was observed (Huang et al., 2020).

On the other hand, the relations between each domain of these behaviors with well-being and QoL are less investigated and the prevalence in the distribution of these behaviors can differ between population's groups. In an investigation including adults from 104 countries with data from 2002 to 2019 (Strain et al., 2020), the domains in which people more accumulated PA was occupational PA (OPA) (52%), followed by transport-related PA (TPA) (36%), and LTPA, which was responsible for only 12% of the total weekly PA. In low-income countries, LTPA accounted for only 4% of weekly PA, while the occupational domain accounted for 57%, and among women, TPA was higher than in men. Another investigation among adults, with data from 2,649 participants (20-75 y; 50% female), indicated that most PA is accumulated during work (50% of total PA; 1.2 h/d) and home-related activities (28% of total PA; 0.7 h/d). Participants reported less LTPA (15%; 0.4 h/d) and even less TPA (2%; <0.1 h/d). In the same study, men performed more PA than women (2.9 hours/day *vs* 2.1 hours/day; p<0.01), mainly driven by LTPA and OPA (Saint-Maurice et al., 2021).

Furthermore, there are less investigations about the prevalence of the domains of SB, but one European study with 8,471 Dutch adult (median age 55 years old, 55% men), indicated that they had an average 9.1 h/day (57% of waking hours) of SB during weekdays and the domain most prevalent was the leisure-time (5.3 h/day [33% of waking hours]), followed by occupation (2 h/day [13% of waking hours]), and transport-related (0.5 h/day – 3% of waking hours]) (Bakker et al., 2020). On the other hand, in a study performed in an American University (n=272, median age 20, 79% female), undergraduates reported spending a total of 12.7 h per day engaged in SB with the largest proportion of their time (35%) spent engaged in recreational screen-related sedentary activities (an average 4.5 h/day), and the time spent in occupational SB was on average 3.4 h/day (school and work-related sedentary activities) (Carpenter et al., 2021).

Data gathered from 98 investigations published until 2015 (White et al., 2017) indicated that the domain in which PA is predominantly accumulated influences the relationship between PA and mental health/illness and that LTPA and TPA can be the domains most associated with mental health indicators, as opposed to OPA and housework. In addition, it was found that leisure-time SB, characterized as mentally passive (e.g., watching TV), can increase the risk of depression in adults, while there was no harm associated with mentally active SB (e.g., using the computer at work/school or reading) (Huang et al., 2020), suggesting that the domain can play an important role in the association between PA/SB and well-being/mental health measures. However, in Europe and particularly in Portugal, this topic is less explores, despite being the country with one of the most lowest life satisfaction indexes of the Organization for Economic Co-operation and Development (OECD), with an average score of 5.8 (index ranging from 0 to 10), which is lower than the average OCDE countries of 6.7 (OECD, 2021) and have more than 60% of the adult population in depression risk according to OCDE Health at Glance 2022 (OECD, 2022).

Finally, recent studies have called attention for the importance of the domain (or context) where PA and SB are performed or accumulated, and its relationship with health, because most investigations that lead us to create the PA public recommendations are based a) mainly on LTPA data; b) on questionnaires that do not appropriately assess incidental SB/PA and underestimate total SB/PA, and c) for each domain, there are ethnic, racial, sex, and socioeconomic disparities that must be taken into consideration by the scientific community (Quinn & Gibbs, 2023; Vella et al., 2023; Wendt et al., 2024) indicating that, although the relations between PA and SB are well established, there are gaps in the literature to deepen.

Thus, the following aims were established for this thesis via five studies/papers based on the need to understand the “state of the art” of this topic and further the discussion about the domains of PA and SB and their relations with well-being and QoL. These investigations were based on data from two larger investigations described in the methods section – **chapter II.**

Study 1: Systematic review

To gain a deeper understanding on the correlation between time spent in different domains of PA and SB and its impact on the mental health and illness of adults, a systematic review was performed. This review was set to update the existing evidence and identify key factors already recognized and others that needed to be clarified – **chapter III**;

This systematic review was registered (PROSPERO CRD 42022273834) and was published in the Journal Advances in Mental Health with the following reference:

Teno, S. C., Silva, M. N., & Júdice, P. B. (2024). Physical activity and sedentary behaviour-specific domains and their associations with mental health in adults: a systematic review. Advances in Mental Health, 1–28. https://doi.org/10.1080/18387357.2024.2324099

Study 2: Correlates of life satisfaction

Our second aim was to identify, among several health correlates, those that potentially are harmful/improve life satisfaction, i.e., a measure of subjective well-being, using cross-sectional data from an academic environment – **chapter IV.**

This article is submitted for publication in a peer-reviewed journal with the title: “An analysis of health-related correlates of life satisfaction in adults in a university environment. Is physical activity always good?” and is currently under review.

Study 3: Domains of physical activity

Our third aim was to assess, through cross-sectional data, the potentially different associations between being physically active (i.e., meeting the current PA recommendations) during leisure-time or via IPA in several health and mental indicators. Besides that, our aim was to investigate these differences by sex – **chapter V**.

This work was orally presented at the scientific congress (CONGRESSO DE EXERCÍCIO E SAÚDE CIDEFES/MANZ – PORTUGAL FIT 2023) under the authorship of Sabrina C. Teno, Marlene N. Silva e Pedro B. Júdice.

This article is submitted for publication in a peer-reviewed journal with the title: Leisure-Time vs. Incidental Physical Activity Benefits Health-related Quality of Life and Adherence to Mediterranean Diet in Adults - and is currently under review.

Study 4: Domains of sedentary behavior

Our fourth aim was to identify the associations between SB from three different domains with psychological well-being, life satisfaction, and QoL – **chapter VI.** This investigation was presented at the scientific congress (CONGRESSO DE EXERCÍCIO E SAÚDE CIDEFES/MANZ – PORTUGAL FIT 2023) under the authorship of Sabrina C. Teno, Marlene N. Silva e Pedro B. Júdice on poster format.

Furthermore, it was published on BMC Public Health with the following reference:

Teno, S.C., Silva, M.N. & Júdice, P.B. (2024) Associations between domains of sedentary behavior, well-being, and quality of life – a cross-sectional study. *BMC Public Health* 24, 1756 https://doi.org/10.1186/s12889-024-19252-9

Study 5: Sitting time and well-being and quality of life

Our fifth aim was to evaluate, through 6 months of longitudinal investigation, the impact of the reduction of sitting time with sit-stand desks in the workplace (occupational domain) and its impact on sedentary workers' well-being and QoL – **chapter VII**.

This work was presented in a poster/presentation format at the 29th Annual Congress of the European College of Sports Science (ECSS) in July 2024. The letter of acceptance is in the attachments section. Besides that, this investigation was published on Ergonomics Journal with the reference:

Teno, S. C., Silva, M. N., Silva, H. & Júdice, P. B. (2024). Longitudinal analysis in sitting time and impact on well-being and quality-of-life of sedentary workers https://doi.org/10.1080/00140139.2024.2441451.

This thesis also includes **chapter VIII**, which summarizes the results of all studies, including a section for general conclusions integrating all findings, future directions, and strengths and limitations of this thesis. In addition, the general bibliography and annexes are included alongside the post-textual elements. Attached are the questionnaires used in the two main studies (annex I and II), the ethical approval for both (annex III and IV), and the letter of acceptance for the congress cited above (annex VI).

Besides that, although nonintegrated in the main body of this thesis, another investigation (annex V) is attached, where it was possible to deepen the knowledge concerning the methods further used in this thesis. This investigation was the winner of a Program of Technical and Scientific Cooperation of the city council of Oeiras – Portugal, during the year of 2022. Through this collaboration, it was possible to publish an article into the amount of PA and SB of 403 users from public parks in Oeiras/Portugal. It was also possible to investigate the distinct correlates associated with the chance of complying with the WHO's overall, moderate, and vigorous PA recommendations. The reference for this study is:

Teno, S. C., Silva, H., & Júdice, P. B. (2023). Correlates associated with the compliance for moderate, vigorous, and overall physical activity recommendations of public park users in Oeiras – Portugal. Cities & Health, 8(1), 59–69. https://doi.org/10.1080/23748834.2023.2280354

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Chapter II

General Methodology

Se a aparência e a essência das coisas coincidissem, a ciência seria desnecessária.

Karl Marx

Chapter II

1. General methodology

This thesis was carried out with data from two large studies described briefly in this chapter. However, throughout the next chapters, the methodology used in each study will be depicted according to the requirements of each one. The thesis was performed according to the American Psychological Association (APA) 7th edition.

1.1. The LusófonAtiva project

1.1.1. Study design

LusófonAtiva project is a study that aimed to design and implement a digital system for monitoring physical behaviors linked to healthy lifestyles in the university context (ILIND/F+/EI/02/2020). This study was developed and implemented at Universidade Lusófona in Lisbon throughout 2021/2022. Participants were recruited online. Invitations were sent via email and university social networks, including a link to the questionnaire (via the Qualtrics platform). For this thesis we just used data from the baseline, collected throughout November 2021.

1.1.2. Participants

All students, teachers, and employees from the university campus who volunteered to participate were included in the study (N=776). Sample sizes may vary according to the variables under analysis, as not all participants completed the entire questionnaire (i.e., they could drop out at any time).

1.1.3. Ethics approval and consent to participate

Participation was entirely voluntary, and anonymity and confidentiality were assured by ethical rules for research on humans. All participants gave their informed consent before completing the questionnaire digitally. The LusófonAtiva project obtained ethical approval favorable granted by the institutional ethics committee of Universidade Lusófona de Humanidades e Tecnologias, on January 20, 2021 (annex III). The protocol complies with legislation, international conventions, and ethical research practices.

1.1.4. Measures and materials

Briefly, LusófonAtiva project assessed, through validated questionnaires, several health indicators including evaluation of sleep (quantity and quality), adherence to mediterranean diet and eating behaviors, body image, and motivational profile for PA or eating behavior. Furthermore, sociodemographic indicators (sex at birth, marital status, body mass index and perceived financial situation), and physical literacy were self-reported. On the next chapter the above measures used for this thesis will be detailed when required.

- Physical activity was assessed with the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). The short form records the amount of activity of four intensity levels performed in the last 7 days (vigorous-intensity activity, moderate-intensity activity, walking) besides the amount of time spent sitting. The IPAQ was chosen because it is an internationally validated questionnaire that has already been tested in several countries and demonstrated acceptable properties of reliability and validity, especially in urban samples (Craig et al., 2003). The cutoff point for being considered physically active or inactive was established in accordance with current WHO recommendations (Bull et al., 2020; Thivel et al., 2018), i.e., "meeting the recommended PA goal" (≥150 min/week of moderate PA or ≥75 vigorous) or "not meeting the recommended PA" (<150 min/week of PA moderate or <75 vigorous). Since we needed to know the domain where PA was performed we used the question "What kind of physical activities do you usually do?" with several response options, ranging from sports (team or individual sports) and physical exercises (running, dancing, strength training, group classes) – classified as 'leisure PA' and an option "I do not practice structured PA", to classify the physical activities as 'incidental PA'.
- Sedentary behavior was also assessed with IPAQ, by asking the duration (the average time in hours per day) that the person spends sitting during a weekday and a weekend day. In addition, to capture the domains of SB, questions were created regarding the time that participants usually sit at work/school (occupational), on transport, and in their leisure-time. The questions were as follows: "On average, how much time do you usually spend sitting at study/work per day?", "On average, how much time do you usually spend sitting making a hobby, watching TV, using the computer/tablet/cell phone for leisure per day", and "On average, how much time do you spend sitting on public/private transport per day?". The answers were weighed by day [min/day])

through the weighted arithmetic average of the responses of the time spent in sedentary behavior on weekdays and weekend days, and the time spent in each domain was used as continuous.

The outcome variables for this thesis were assessed by a set of items representative of each aspect of subjective well-being (i.e., the facet eudaimonic and hedonic) according to recent guidelines for selection of well-being measures (VanderWeele et al., 2020):

- General satisfaction with life (GSL) was assessed with a scale from 0 "not satisfied" to 10 "completely satisfied" about work/course, personal relationships, and free time to do what they like (assessing the hedonic and evaluative facets of well-being) and then, it was calculated as a mean of these 3 items with higher values indicating more life satisfaction.
- Psychological well-being (PWB) (i.e., the eudaimonic facet of well-being) was assessed with the following question: On a scale from 0 to 10, how much do you agree with these statements: "I feel that my life and the things I do are worthwhile" and "I feel my life has purpose and direction". Then the average of the 2 items was calculated, with higher values indicating more well-being and were used as continuous variables in both cases.
- Health-related quality of life (HRQoL) was evaluated through the 12-item Short Form Survey (SF-12) (Gandek et al., 1998b) that is a self-reported method that assesses the health impact on an individual's everyday life, and it is an abbreviated version of his predecessor, the SF-36 (Ware & Sherbourne, 1992) with 36 items. The SF-12 contains a subset of 12 items of the SF-36, with one or two items from each of the eight original questionnaire scales, considered too long for large group comparisons and longitudinal monitoring. The information of all 12 items is used to construct a summary measurement of total (range from 12 to 60 points), physical (PCS – range from 6 to 30 points) and mental component (MCS – range from 6 to 30 points) without losing their reliability. The response options were "never" (5 points), "shortly" (4 points), "some time" (3 points), "most of the time" (2 points), and "always" (1 point). The questions were coded so that the highest score indicated better HRQoL and were used as continuous variables.

1.2. Stand up for healthy aging - SUFHA study

1.2.1. Study design

SUFHA study was a two arm (1:1), superiority parallel-group cluster randomized controlled trial, with measurements at baseline and 6 months follow up. The trial was prospectively registered (details at: https://doi.org/10.17605/OSF.IO/JHGPW; Registered 15 November 2022. OSF Preregistration) and has been previously published (Júdice et al., 2023). The main objective was assessing the effectiveness of a 6-month intervention to reduce sitting time in office based workers using a sit-stand workstation prompted by an initial educational session and ongoing motivational prompts. The second objective was to assess the impact of this reduction on several health outcomes.

1.2.2. Participants

Inclusion criteria for the intervention consisted of the suitability to install the sit-stand desk; working at least 0.6 full-time; being more than 20 years-old; and spending at least 70% of a working week performing desk-related activities. Exclusion criteria consisted of workers already using a sit-stand desk; workers without a personal workspace where a sit-stand desk could be assembled; or workers with musculoskeletal disorders/health conditions inhibiting their ability to work in a standing position.

Recruitment took place between December 2022 and January 2023 via university advertisements (e.g., banners, posters, invitation institutional emails, and face-to-face word of mouth), with baseline data collection in February 2023 and follow-up data collection in August 2023.

1.2.3. Ethics approval and consent to participate

All participants provided written informed consent and the project was approved by the ethics commission of the Faculty of Physical Education and Sport at the University of Lusofóna in Lisbon (Approval number D0522) (annex IV).

1.2.4. Intervention

The intervention group received a sit-stand desk (Vinsetto, Model 923-043 – Figure 1), which was installed on top of a conventional workplace desk by means of a clamping arm. To enhance desk use, all participants received an initial psychoeducational session regarding the independent benefits of reducing and interrupting sitting time with standing. Moreover, motivational nudges were delivered via email and on the SUFHA's website (https://sufha.ulusofona.pt/) during the intervention period to support relatedness, perceived competence, and autonomy to use the desk. It was included a waiting-list control group who only attended the initial psychoeducational session regarding the independent benefits of reducing and interrupting sitting time with standing, with no contextual change during the 6-month intervention (i.e., no access to the sit/stand desk or any other prompt). After the intervention period, the waiting-list control group had access to the sit-stand desks.

Figure1: Sit-stand desk Vinsetto, Model 923-043

1.2.5. Measures and materials

Primary and secondary outcomes were assessed at baseline and at the end of the 6-month intervention period (Figure 2). Sedentary and PA pattern data was collected using an ActivPAL inclinometer/accelerometer monitor (model ActivPAL4; PAL Technologies Ltd., Glasgow, UK). Participants wore the device on their right thigh 24 h/day for 7 days at baseline, repeating this assessment at the end of the intervention (6 month). The ActivPAL is designed to combine data from an inbuilt inclinometer and accelerometer, making it the leading objective method for monitoring sedentary activity and transitions between different behaviors. Positioned on the thigh, the ActivPAL can differentiate between standing (vertical position) and sitting or lying (horizontal position), while the accelerometer data allows it to distinguish between stationary upright activities (i.e., standing) and upright activities with movement (i.e., stepping).

It is important to highlight that in the evaluation moments, the participants received an explanation how to use the ActivPal (i.e., without ever taking it off and do not perform an aquatic activity that maintains prolonged contact with water, like diving or swimming). Besides that, the investigators involved in the study also placed the ActivPal on the thigh with the aid of a waterproof pharmacological dressing to guarantee the standardization of the proceeds.

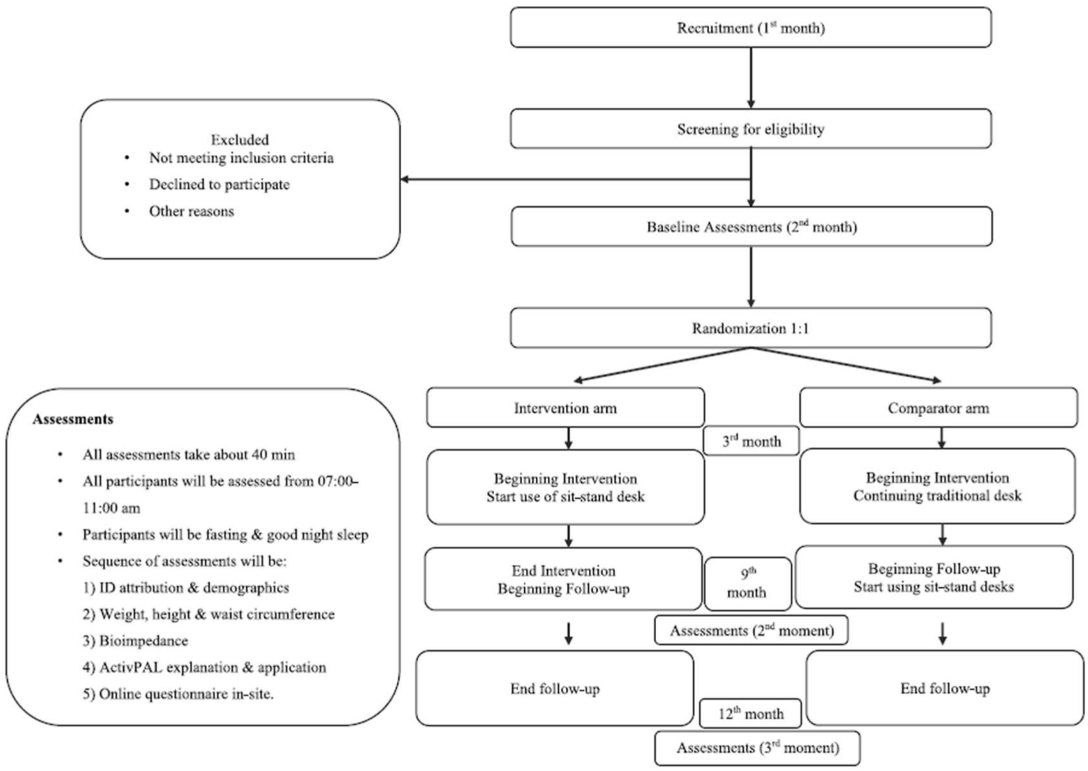


Figure 2: Flow diagram of enrolment, interventions, assessments, and visits for participants

Information on age, sex, country of birth, education, financial status, occupation, and tasks assignment/duties, working hours and years of work, current smoking status, presence of chronic disease, and total use of medication and eventual changes in medications were self-reported through an online questionnaire.

Besides that, the secondary outcomes included: body composition, assessed with a phase-sensitive single-frequency bioimpedance analyzer (BIA) (101 Anniversary, Akern, Florence, Italy), body mass index (BMI) where the participants were weighed while wearing minimal clothes and without shoes, on an electronic scale (TANITA BC-601 scale), and the height was measured with a stadiometer (Seca, Hamburg, Germany). BMI was calculated as body mass (kg)/height2 (m).

The outcome variables for this thesis were assessed through the following instruments:

- Quality-of-life was assessed by the EUROHIS-QOL 8-item instrument (Buratta et al., 2003). The EUROHIS-QOL-8 is a measure of quality-of-life composed, as the name implies, of eight items and developed from the generic instruments WHOQOL-100 (The

World Health Organization, 1995) and WHOQOL-Bref. Response adequate to each statement/item, i.e., the first item (How would you rate your quality-of-life?) has a response from 0 (“very bad”) to 4 (“very good”), with 1 being “bad”, 2 being “not good or bad”, and 3 being “good”. For items 3 and 7, the answers range from 0 (“nothing”) to 4 (“completely”), and the remaining items range from 0 (“very unsatisfied”) to 4 (“very satisfied”). The result is a global index, calculated from the sum of the eight items, and a higher value corresponds to a better perception of quality-of-life. The results range from 0 (worse quality-of-life) to 32 (better quality-of-life). In the pilot study, the EUROHIS-QOL-8 had a Cronbach's α of.78 (Buratta et al., 2003), and in the initial field study, which involved a sample of 10 countries, it presented a Cronbach's α of.83 (Schmidt et al., 2006).

- Subjective well-being was assessed by The World Health Organization Five Well-being Index (WHO-5) (Topp et al., 2015), which compresses 5 items, evaluated on a 6-point Likert scale ranging from 0 (“never”) to 5 (“all the time”). The questionnaire only contains positively phrased items: (1) ‘have felt cheerful and in good spirits’, (2) ‘I have felt calm and relaxed’, (3) ‘I have felt active and vigorous’, (4) ‘I woke up feeling fresh and rested’ and (5) ‘My daily life has been filled with things that interest me’. The respondent was asked to rate how well each of the 5 statements applied to him or her when considering the last 14 days. Each of the 5 items is scored from 5 (all of the time) to 0 (none of the time). The raw score therefore theoretically ranges from 0 (absence of well-being) to 25 (maximal well-being). The WHO-5 was evaluated as a psychometrically sound brief measure with non-invasive questions that tap into the subjective well-being of respondents (Sischka et al., 2020). It is important to highlight that a qualified evaluator was on hand to provide immediate assistance to ensure the reliability of responses to the psychological questions.

Chapter III

Study 2: Systematic review

Nada na vida deve ser temido, somente compreendido. Agora é hora de compreender mais para temer menos.

Marie Curie

Chapter III

Physical activity and sedentary behavior-specific domains and their associations with mental health in adults: a systematic review. *[1]

Abstract

The relationship of specific domains of physical activity (PA) and sedentary behavior (SB) (i.e., leisure, work, home, transportation) with mental health/illness is still unclear. Thus, we systematically gathered the evidence that examined the relationship between specific domains of PA and SB with measures of mental health/illness in adults. The review was conducted according to PRISMA criteria, and the search was carried out in the PubMed, SportDiscus, and APA PsychInfo databases. The studies presented a medium to low risk of bias, according to the criteria chosen. The search resulted in 155 records, of which 26 were included with 538,206 people involved. The majority of the studies assess the domain of "leisure", both PA and SB. Based on the gathered information, leisure-time PA was the domain most associated with mental health. Transportation and occupational PA were associated with better mental health in European countries but not in women from lower social classes. Conversely, leisure-time SB was the domain most associated with deleterious mental health outcomes, especially among inactive people. These findings may add to the current public recommendations on PA, stressing the importance of the domain, in addition to the amount and intensity.

[1] Teno, S. C., Silva, M. N., & Júdice, P. B. (2024). Physical activity and sedentary behaviour-specific domains and their associations with mental health in adults: a systematic review. Advances in Mental Health, 1–28. https://doi.org/10.1080/18387357.2024.2324099

1. Introduction

To counteract the current epidemic of physical inactivity (Kohl et al., 2012; Nikitara et al., 2021) and reduce the burden of noncommunicable diseases, the main national and international health entities have highlighted the health damage associated with excessive sedentary behavior (SB) and insufficient amounts of physical activity (PA), issuing public recommendations based on the best scientific evidence. This evidence supports the recommendation for adults (18-64 years) of at least 150–300 minutes of moderate-intensity aerobic PA (or 75–150 minutes of vigorous-intensity PA) or an equivalent combination throughout the week. Furthermore, the guidelines recommend regular muscle-strengthening activity and the reduction of SB, although evidence is still insufficient to quantify a specific SB threshold (Bull et al., 2020).

SB is defined as any activity while awake, with ≤1.5 metabolic equivalents, in a seated or reclining posture (Tremblay et al., 2017), and excessive accumulation has been associated with all-cause mortality, cardiovascular disease, type II diabetes, abdominal obesity, some types of cancer, and depression (Huang et al., 2020; Júdice et al., 2015; Patterson et al., 2018). PA is defined as any voluntary bodily movement produced by skeletal muscles that requires energy expenditure (Caspersen et al., 1985), and its benefits include a lower risk of cardiovascular disease, hypertension, obesity, diabetes, breast cancer, and colon cancer (Pedersen & Saltin, 2015), a lower risk of depression (Pearce et al., 2022), and improved quality of life and well-being (Marquez et al., 2020).

Public recommendations report that PA can be accumulated in the most diverse domains, such as leisure-time (LTPA), transportation or commuting (TPA), and domestic or occupational activities (OPA) (Caspersen et al., 1985; Howley, 2001). SB can also be accumulated in the same domains (e.g., watching TV or playing video games – considered "leisure", in transportation from and to home/work/school when sitting, and during working hours) (on behalf of SBRN Terminology Consensus Project Participants et al., 2017). In recent years, evidence has shown that different populations (i.e., ethnic, age, and sex) accumulate PA and SB in different manners, and the domain in which PA and SB are partaken can impact overall health status (Cillekens et al., 2020, 2021; Fluharty et al., 2020), specifically mental health (White et al., 2017). A previous investigation including adults from 104 countries with data from 2002 to 2019 (Strain et al., 2020) examined the domains in which people accumulated moderate to vigorous-intensity PA (MVPA), and the results indicated that most MVPA was accumulated as OPA (52%), followed by TPA (36%), and last, LTPA was responsible for 12%

of the total weekly MVPA. In low-income countries, LTPA accounted for only 4% of weekly MVPA time, while OPA accounted for 57%, and among women, TPA was higher than in men.

Mental health is defined by the World Health Organization (WHO) as a positive well-being state in which individuals realize their full potential, experience positive emotions, can cope with stress, maintain positive interpersonal relationships, work productively, and contribute to their community (World Health Organization, 2005). It has been assessed both through a positive perspective (e.g., subjective well-being, life satisfaction) and from a negative perspective (e.g., risk, incidence or symptoms of depression, anxiety, or psychological distress). According to the WHO, mental disorders are one of the largest causes of disability worldwide, and an estimated 418 million disability-adjusted life years (DALYs) could be attributable to mental disorders in 2019 (16% of global DALYs). The value associated with this burden is estimated at 5 trillion USD (Arias et al., 2022), making mental health an important factor in achieving global development goals, and studies focusing on their promotion, an emerging research field (Mielke et al., 2014; Ştefan et al., 2019; White et al., 2017).

Data gathered from 98 investigations published until 2015 (White et al., 2017) indicate that the domain in which PA is predominantly accumulated influences the relationship between PA and mental health/illness and that leisure and transportation PA can be the domains most associated with mental health, as opposed to OPA and housework. In addition, it was found that leisure-time SB, characterized as mentally passive (e.g., watching TV), can increase the risk of depression in adults, while there was no harm associated with mentally active SB (e.g., using the computer at work/school) (Huang et al., 2020), suggesting once again that the domain can play an important role in the association between SB and mental health.

Thus, considering the current PA recommendations (i.e., where the domains are not taken into consideration) and the fact that PA and SB can be accumulated in distinct domains, this systematic review seeks to update the existing information to better understand how the time spent in these various domains can distinctively affect mental health and mental illness in adults.

2. Method

This review was a priori registered (PROSPERO CRD 42022273834 and executed according to the PRISMA guidelines (Page et al., 2021).

2.1. Inclusion criteria

- Having a quantitative assessment of PA and SB in at least one specified domain (e.g., LTPA, OPA or household chores and TPA). In the case of studies conducted only within a specific domain (e.g., leisure or work), no specific PA and SB domain measurements were needed.
- Have a quantitative evaluation of at least one variable related to mental health/illness. This option follows the previous meta-analysis (White et al., 2017) including terms related to mental health (mental well-being; psychological well-being; subjective well-being; life satisfaction) as well as terms related to mental illness (depression; depressive; anxiety; stress; psychological distress; mental disorder; mental illness);
- Participants must be between 18 and 64 years old.
- Have a quantitative evaluation of the relationship between PA and SB in a specific domain and mental health/illness.
- Cross-sectional, longitudinal, or experimental investigations were included.
- Peer-reviewed journal articles with full text and published in English.

2.2. Exclusion criteria

- Studies including physically frail participants, patients with serious chronic diseases, such as arterial coronary disease, diabetes, and stroke, pregnant women or in the puerperium, and people with chronic pain were excluded, as specificities related to the condition may confuse the relationship between domains of PA and CS and mental health (i.e., the aim of this study) (Turner & Kelly, 2000).
- Studies including professional athletes: the practice of exercise can be perceived as part of the job (not leisure).
- Studies including evaluation of overall PA or SB and that were not clear about the domain in which PA and SB were performed.
- Studies performed in a particular environment or circumstance (e.g., stress at work or within the hospital setting) or specifically during the period of isolation from the COVID-19 pandemic were excluded due to the independent psychological impact of the specific setting or quarantine. *Per se,* these circumstances can raise anxiety, depression, distress and posttraumatic symptoms experienced by adults (Bonati et al., 2022).

2.3. Database and search strategy

Concerning PA, the search was carried out in the following databases: PubMed, SportDiscus, and APA PsychInfo in August 2022 and restricted to articles published in the past 6 years, between January 2016 and August 2022, due to a similar prior meta-analysis that included data until the end of 2015 (White et al., 2017). Regarding SB (as no previous review was performed), the search was expanded for articles published in the last 10 years (2012 - 2022). The search results were exported to Zotero® reference management software, and the keywords used during the search are described in Table 1. The keywords PA + domain + mental health or mental illness were combined, followed by the keywords SB + domain + mental health or mental illness.

Table 1: Keywords for searching

Physical activity	Sedentary behavior	Domain	Mental/health or illness
physical activity; exercise; physical exercise	screen-time; sitting time; sedentary behavior; sedentary domain specific; TV viewing	domain; types of; leisure time; active commuting; household; housework; occupational; domain-specific recreational; domestic; active travel; transport	mental health; mental well-being; psychological well-being; subjective well-being; life satisfaction; depression; depressive; anxiety; stress; psychological distress; mental disorder; mental illness; welfare

Note: The keywords were used combining keywords of PA + the domain + mental health or mental illness, and the keywords for SB + the domain + mental/health illness

2.4. Selection of studies and data extraction

Two researchers independently assessed the title and abstract of each study, and records recommended by both were excluded. After this, both independently screened the full text of the remaining studies, recommending each one for inclusion or exclusion. Discrepancies were resolved by discussion between them. Data were extracted from each article into a predefined data extraction form. All data were reviewed for accuracy, and discrepancies were discussed and solved.

2.5. Risk of bias in individual studies

The same criteria followed in the previous meta-analysis were considered (White et al., 2017), and six criteria were defined and adapted from the STROBE declaration (von Elm et al., 2007) for observational studies and the CONSORT declaration (Moher et al., 2001) for experimental studies. We attributed the value “1” (present and explicitly explained) or “0” (absent or inadequately described) for each study in each criterion, and the summed values determined the risk of bias, as follows: 1 and 2 points as high risk of bias, 3 and 4 points as medium risk of bias and 5 or 6 points as low risk of bias. The criteria were as follows:

1. Random selection of participants (sampling procedures were appropriately and adequately described, including the randomization process for experimental studies);
2. Eligibility criteria of the participants were declared, and there was an adequate description of the study sample;
3. Valid (questionnaire, items of questionnaire or instruments) evaluation of PA participation (or valid evaluation of SB), including membership in a PA program/exercise;
4. Valid assessment of mental health or mental illness;
5. Covariates adjusted in analyses related to PA/SB and mental health (e.g., sex, socioeconomic status, and age);
6. Power calculation was reported, and the study was adequately fed to detect hypothetical relationships.

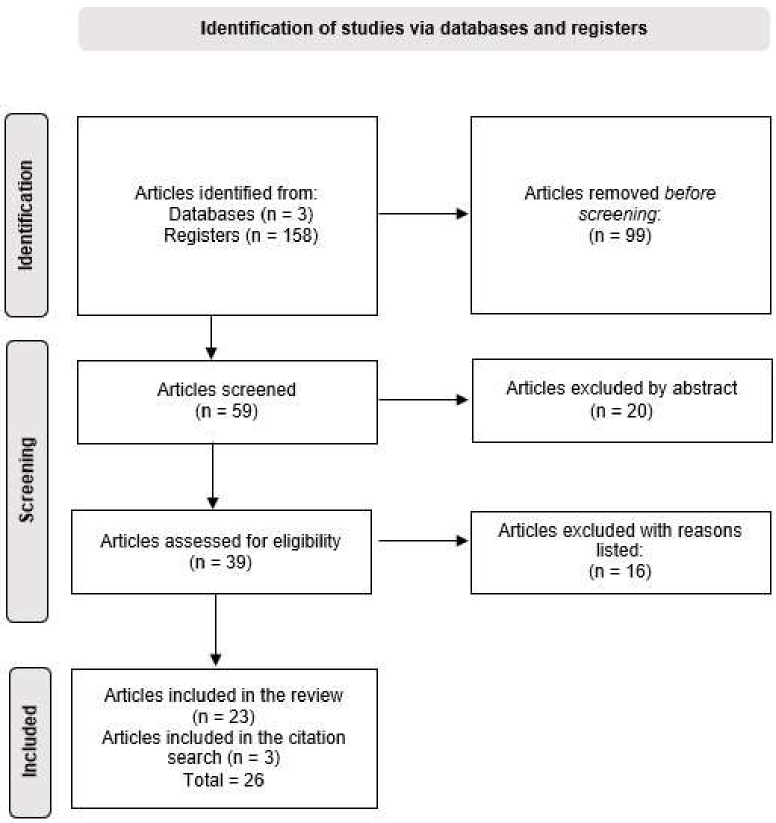
3. Results

3.1. Selection of studies

The primary search identified 158 studies. First, 99 studies were excluded based on the title, and after reading the abstract, another 20 did not meet the inclusion criteria, leaving 39 articles for full-text reading. After reading the full texts, 16 studies were withdrawn for the following reasons: 1. The aim was to evaluate the effects of LTPA in only one exercise session (Matzer et al., 2018); 2. The structure of the workspace (design of chairs and table) was assessed (Lindberg et al., 2018); 3. Evaluated LTPA in video games and with a limited number of sessions (Monedero et al., 2017); 4. Evaluated stress exclusively at work (Gerber et al., 2018, 2020; Kurspahić-Mujčić & Mujčić, 2019; Mohebb et al., 2019); 5. It was a pilot study for well-being at work (Haile et al., 2020); 6. The evaluations took place during a specific period

(COVID-19 pandemic) (Cheval et al., 2021; Meira et al., 2020); 7. The evaluation of LTPA included TPA in the same measure (Holstila et al., 2017; Lahti et al., 2017); 8. It was a comparison between team sports (Margulis et al., 2021); 9. Measured SB without specifying the domain (Watts et al., 2017); 10. Evaluated employees with osteoarthritis (Mulla et al., 2018); 11. Analyzed mediators (Briki, 2018). After all the screening processes, twenty-three studies remained for the final analyses, (Atkin et al., 2012; Changwook Kim et al., 2021; Chu et al., 2018; De Cocker et al., 2021; Edwardson et al., 2018; Fang et al., 2019; Felez-Nobrega et al., 2020; Fernandez-Montero et al., 2020; Hamer & Stamatakis, 2014; Jakobsen et al., 2017; Jo et al., 2021; Kekäläinen et al., 2019; Marques, Peralta, Gouveia, et al., 2020; Mason et al., 2016; Neumeier et al., 2020; Sheikh et al., 2018; Siefken et al., 2019; Sliwa et al., 2016; Tharrey et al., 2020; Werneck et al., 2019, 2020, 2021; Zheng et al., 2018), and three (F. B. Schuch et al., 2021; Teychenne et al., 2017; White et al., 2020) were also included by citation searching, totaling 26 investigations, as shown in Figure 1.

Figure 1: Systematic review flow diagram



3.2. Study characteristics

Table 2 presents the characteristics of the included studies, organized by author and year of publication; country/continent; study design; population (with mean age, sex, and if applicable, intervention groups); the domains of PA and SB; PA or SB measurement; mental health/illness measured, main finding and summary. Of all included studies, 73% were published between 2018 and 2021 and were mainly observational (77%), with a sample size ranging from 50 to 261,121 participants. Of the studies that only measured one domain of PA (73%), the majority measured LTPA (58%), with one study exclusively examining TPA (5.2%), two studies focusing on OPA (10%) and seven studies measuring multiple domains of PA (27%). Of the five studies that only measured SB (19%), three measured leisure-time SB (60%), one study measured SB at work (20%), and one study measured multiple domains of SB (20%). Finally, two investigations (7.6%) assessed multiple domains of PA and SB simultaneously. In addition, excluding the experimental studies (23%), the predominant method of physical behavior assessment was by questionnaire or some items of validated questionnaires (77%), with only two studies (8.2%) using an objective method (i.e., accelerometer). Study characteristics are presented in table 2.

Table 2: Information on the articles included.

Author and year	Country/ continent	Study design	Population	Domain	Instrument/PA Measurement	Instrument/Health measure/mental illness	Findings	Domain/Association direction or effect/result
Mason et al., 2016	Scotland	Observ	2654 participants - 59% women, residents of 32 deprived neighborhoods in Glasgow Ages: 16 to 24 years: 9.4% 25 to 39 years; 30.3% 40 to 54 years: 29.6% 55 to 64 years: 13.0% + 65 years: 17.8%	LTPA TPA OPA PA Domestic PA Familiar (leisure)	IPAQ short form + Questions about PA in each domain	WEMWBS Mental Component Summary (MCS)(MCS-12) from the SF-12v2 Health Survey	The significative relations were between active travel (to those who had level moderate and high IPAQ) and MCS-12 and WEMWBS; between leisure PA (to those who had level moderate and high IPAQ) and WEMWBS; and between family activities and WEMWBS. PA domestic and OPA doesn't associate with MCS or WEMWBS and higher levels of general PA showed no significant association with better mental health.	LTPA= ↑ well-being TPA= ↑ well-being
Sliwa et al., 2016	USA	Observ	385 immigrant and Latino women (average age: 36 years old)	OPA	Items from the Pregnancy PA questionnaire (PPAQ) and Kaiser Physical Activity Survey (KAPS)	CES-D 20-item scale	The chances of reporting high depressive symptoms were 2 x higher for women in the highest quartile of OPA compared to those in the lowest quartile.	OPA= ↑ depressive symptoms
White, et al., 2020	Australia	Observ	1080 women - average age: 41.2 years old – 3 categories: 1. "Professionals" (managers, administrators, and professionals) 2. "clerical, sales, and service workers" 3. "tradespersons, transport workers, and laborers"	OPA TPA	IPAQ - Long form	GHQ-30	Those with trade, labor, or transport-related occupations, who reported some work-related walking, have significantly lower psychological distress than those who reported no work-related walking. However, in contrast, there were no significant associations between work-related PA of any intensity and psychological distress for 'professionals' or 'sales and service workers'	TPA= ↓ distress OPA= no association with GHQ
Jakobsen et al., 2017	Denmark	Exper	200 female healthcare workers - average age: 42 years old: G1 (n=89): individual home exercises G2 (n=111): a physical exercise in the workplace in groups	LTPA	N/A	Component of vitality and mental health from SF-36 Second version of the Copenhagen Psychosocial Questionnaire (COPSOQ) Pain Catastrophizing Scale	There was no significant difference between the groups (p=0.563) for mental health, however, vitality, control, and concern with pain improved more after participation in the work exercise group than in the home exercises group (all p <0.05).	LTPA - ↑ vitality, improved control and concern with pain
Sheikh et al., 2018	Norway	Observ	10325 participants - 54% women – average age: 47 years old of the Tromsø Study were followed up for 13 years	LTPA	"How is your average weekly PA in leisure time during the past year? + 1 question about the intensity	Hopkins Symptom Check List-10	After several adjustments, the higher weekly frequency of LTPA, both of mild intensity and MVPA, gave protection against psychological distress in follow-up. The lower frequency of MVPA was associated with a higher risk of clinically significant psychological distress. Among men (14%) and women (15%).	LTPA= ↓ risk psychological distress
Zheng et al., 2018	Australia	Exper	50 participants - 81% women considered to have high-stress levels - average age: 33 years old	LTPA	N/A	State-Trait Anxiety Inventory	Significant improvements for groups G1 and G2 for state anxiety (p<0.05) and trait (p<0.05), PSS14 (p<0.05), mental health domain (p<0.05),	LTPA = ↑ mental health

			G1 (n=17) Tai chi - 5 h/sem G2 (n=17) exercise in a fitness center– at least 2 h/week GC waiting list (n=16)			Perceived Stress Scale 14 (PSS14) SF-36	and vitality domain ($p < 0.05$) in SF-36, compared to CG. Higher results were observed for G1 for state and trait anxiety ($p<0.001$) and mental health domain SF 36 ($p<0.05$)	
Fang et al., 2019	Taiwan	Exper	75 participants - 60% overweight women - average age: 37.4 years old G1 (n=37): Moderate-intensity exercise instructions (3x/week - 60 min) CG (n=38): maintain the usual routine	LTPA	N/A	WHOQOL-BREF - Taiwan version The occupational work stress inventory	G1: scored more in four domains of the concept of QOL (+8.6% in physical health, +5.1% in psychological health, +12.9% in social relations, and +4.9% in the environment) ($p<0.001$) and ↓ the level of stress at work ($p<0.05$) CG: No changes in stress and QoL ($p > 0.05$).	LTPA = ↑ QOL
Kekäläinen et al., 2019	Finland	Observ	303 participants in the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) study were analyzed at 42 and 50 years old	LTPA	"How often do you exercise or play sports in your leisure time?"	Questionnaires: mental well-being, happiness, positive mood, psychological well-being scales, social well-being.	Different types of LTPA were positively associated with subjective health and different dimensions of mental well-being. However, LTPA and subjective health showed no longitudinal associations and there was ≠ between men and women, because "rambling by nature" was related to better emotional well-being and subjective health only among men.	LTPA= ↑ well-being
Siefken et al., 2019	Australia	Observ	682 physical exercise practitioners - 53% women - average age: 33 years old	LTPA	'In the last 12 months, how often have you been involved in LTPA per week? ' + questions about indoor or outdoor PA, intensity, and type of PA	CES-D Generalized Anxiety Disorder Scale (GAD-7)	Scores in the assessments of depression and anxiety were observed: 1. Lower, for participants of indoor team games, followed by individual outdoor practitioners (small effect). 2. Those who did not meet weekly PA recommendations reported depression + high scores 3. Higher depression scores were observed in people with + PA of vigorous indoor intensity.	LTPA indoor games = ↓ depression and anxiety LTPA high intensity = ↑ depression
Fernandez-Monteiro et al., 2020	Spain	Observ	15488 participants - 59% women, average age: 37 years old	LTPA	Spanish version of nurses′ health study and health professionals' PA questionnaire	Depression was diagnosed by a doctor	Participants with higher total LTPA (METs-hour/week) and longer duration of LTPA (hours/week) showed a lower risk of depression, while the intensity of LTPA (MET) showed no association with depression.	LTPA= ↓ risk of depression
Marques, et al., 2020	20 countries in Europe	Observ	29285 participants - 52% women - average age: 50 years old of the European Social Survey round 7.	LTPA	"In how many of the last 7 days walked quickly, practiced sport for 30 minutes or more?"	CES-D	Involvement in LTPA was negatively and linearly related to depressive symptoms, regardless of sex, age, area of residence, having children, marital status, social class, and educational level.	LTPA= ↓ depressive symptoms
Neumeier et al., 2020	Austria	Exper	73 participants - 65% women (average age: 46 years old)	TPA	Intervention - online diary + Polar® M200 watch.	HRQOL – SF-36 German version	Significant positive changes in G1 were observed in four subcomponents of the SF-36: physical functioning ($p=0.023$), mental health ($p=0.036$), vitality ($p = 0.005$) and general health ($p=0.004$)	TPA= ↑ QOL

			G1(n=51): bicycles (26 participants) or public transport + walks (25 participants) CG (n=22): maintain the usual routine				compared to CG. In the G1, the people who took the bike path presented more statistically significant changes in HRQOL than people who used public transport and walks.	
Tharrey et al., 2020	France	Quasi-exper	132 participants - 50% women - average age: 44.4 years old G1 (n=66) - community garden CG (n=66) - noncommunity garden participants	OPA	Triaxial accelerometer (wGT3X-BT)	WEMWBS	No significant differences were found in mental well-being among community garden participants, compared with nonparticipants.	OPA= no changes in well-being
Werneck et al., 2020	Brazil	Observ	60202 participants in the National Health Survey - 57% women – average age: 42 years old	LTPA OPA TPA PA Domestic	Questionnaire of the Risk and Protective Factors Surveillance System for Chronic Diseases	PHQ - 9	LTPA was associated with depressive + low symptoms, and TPA was associated with depressive symptoms lower only among elderly individuals. On the other hand, OPA and domestic were associated with higher depressive symptoms in adults, especially in women.	LTPA= ↓ symptoms depression TPA= ↓ symptoms depression (older adults) OPA= ↑ depressive symptoms
Changwook et al., 2021	USA	Observ	7108 participants in 3 phases: 1995-96: average age 46 years old and 48.3% women 2004–2006: (n=4955) average age 55 years old - 53.8% women 2013–2014: (n=3294) average age 64 years old - 55.2% women	LTPA	"How often do you get involved in moderate/intense PA during leisure or free time? "	9-item version of the Positive and Negative Affect Schedule. Ryff's 18-item Psychological Well-being Scale. Key's 15-item Social Well-Being Scale	The results showed that the initial level of moderate LTPA was associated with good psychological and social functioning over time and vice versa. However, vigorous LTPA at the beginning of the study was related only to the growth of emotional functioning.	LTPA= ↑ psychological, emotional and social functioning
De Cocker et al., 2021	Europe	Observ	261121 participants - 52.4% women - 76% adults, recruited from the European Health Interview Survey Ages: 18–34: 54342 participants 35–64: 136869 participants 65+: 69910 participants	LTPA TPA OPA	EHIS-PAQ – assess PA on work, transportation, and leisure + aerobic activities + muscle strengthening	PHQ-8	Performing any level of PA in any domain was associated with a lower prevalence of mild, moderate, moderate-severe, and severe depressive symptoms.	LTPA= ↓ depression TPA= ↓ depression OPA= ↓ depression
Jo et al., 2021	South Korea	Observ	1888 participants - 56.6% women <50 years= 517 50-60 years = 718 ≥ 60= 653	LTPA	Question about the practice of LTPA (leisure walking, gymnastics, or exercises)	CES-D 20-item version	There was a 43.7% lower risk of depressive symptoms among those who performed more than the recommended minimum of LTPA than those who did not have LTPA. Regardless of the intensity, there was a significant tendency for women to present a frequency of depressive symptoms at the recommended minimum of LTPA.	LTPA= ↓ depression
Schuch et al., 2021	Brazil	Observ	14381 participants civil servants from public higher education - 54.5% female – 67.5%	LTPA TPA	IPAQ long form+ items developed to study	The Brazilian version of the Clinical Interview Schedule-Revised (CIS-R)	Spending a low volume (60–89 min) or a high volume (>300 min) per week in LTPA was	LTPA= ↓ depressive and anxiety disorder

			45 – 64 years old				associated with lower odds of depressive disorders. High volumes of LTPA were associated with lower odds of co-occurring depressive and anxiety disorders together. Time spent in TPA was associated with a lower prevalence of depressive disorders on 60–89 minutes per week.	TPA= ↓ depressive disorder
Werneck et al., 2021	Brazil	Observ	59722 participants with depressive symptoms - 40% women ages: 18 – 39: 58.3% 40 – 59: 28.7% >60: 12.7%	LTPA	Questionnaire of the Surveillance System of Risk Factors for Chronic Diseases	PHQ -9	PA performed in groups seemed to be more strongly associated with lower depressive symptoms among men than individual activities. In women, no differences in depressive symptoms were observed comparing individual and group PA, compared with inactive ones.	LTPA= ↓ depressive symptoms
Atkin et al., 2012	England	Observ	3490 participants -58% women, average age: 40.4 years old	SB nonoccupational: 1) social or 2) TV viewing, transportation, computer use nonoccupational (or games)	IPAQ short form+ items developed to study	GHQ-12 items	Findings indicate that TV viewing, computer use, and total nonoccupational sitting time were negatively associated with mental well-being in women, independent of potential confounders including PA. In men, only computer use was positively associated with the general health questionnaire-12 scores, and the other SB was not associated.	SB leisure= ↓ well-being
Hamer & Stamatakis, 2014	England	Observ	6359 participants - 54.8% women – average age: 64.9 years old, accomplished for 2 years.	SB leisure (watching TV, use of internet and read)	"How many hours of television do you watch on an ordinary day or evening, that is, Monday to Friday?" and "How many hours of television do you normally watch in total over the weekend, that is, Saturday and Sunday?" (computer/read)	CES-D-8 items	At baseline, the longer time watching TV (passive SB) was associated with higher scores of depressive symptoms, as opposed to internet use and reading (active SB) which were associated with fewer depressive symptoms. No differences in trajectories were observed over time.	SB leisure= ↑ depressive symptoms
Teychenne et al., 2017	Australia	Observ	1033 women living in socioeconomically disadvantaged neighborhoods, as a part of the Resilience for Eating and Activity Despite Inequality (READI) study	SB: TV viewing Computer use Total SB PA: LTPA	IPAQ - Long form + SB was assessed using three measures: TV viewing, computer use, and overall sitting time.	CES-D 10 items	PA and SB in no domain were predictors of the risk of depressive symptoms. Domestic PA and TPA were associated with higher risks of depression after 6-year follow-up	OPA and TPA= ↑ risk depression

				TPA OPA PA domestic				
Chu et al., 2018	Singapore	Observ	2263 participants - 55% women – average age: 45.0 years old of the Asian multiethnic urban population	SB total, leisure, work, and transportation LTPA OPA TPA	Global PA Questionnaire (GPAQ) + items from a domain-specific SB questionnaire and accelerometers	Kessler Screening Scale (K6) - psychological distress GHQ-12 items	The self-reported total SB was not associated with psychological distress and there was no association between domain-specific SB and psychological distress. Total SB per accelerometer was associated with a higher probability of psychological distress with K6. Tertile + high LTPA was associated with less psychological distress with both questionnaires, while there was a significant linear tendency of OPA with psychological distress with K6, but not with GHQ-12. TPA was not related to psychological distress with any measure.	LTPA= ↓ psychological distress SB domain= no associations
Edwardson et al., 2018	England	Exper	146 participants, office workers - 80% women - average age = 41.2 years old G1 intervention: stand desk + instructions, brochure, goals and coaching for SB = 77 CG = 69	SB at work	ActivPAL micro accelerometer (PAL Technologies and ActiGraph (ActiGraph, Pensacola, FL)	Mood Affect Adjective Check List-Revised WHOQOL-BREF	The G1 reduced sitting time after 12 months (−83.28 min/working day) compared with the control. The G1 reduced anxiety at 6 and 12 months of intervention (p=0.002/p=0.004) compared with CG, and CG reduced anxiety generally at 3 months (p=0.002). Between group, significative differences were found in two domains of quality of life (psychological and environmental) and for the overall score at 6 and 12 months (p=0.002 and p=0.005), all in favor of the G1 compared with CG.	↓ SB occupational= ↓ anxiety and ↑ QOL
Werneck et al., 2019	Brazil	Observ	59401 participants - 58% women – average age: 43.3 years old of the 2013 Brazilian National Survey	SB leisure (TV viewing)	Questionnaire of the Risk and Protective Factors Surveillance System for Chronic Diseases	PHQ-9	Accumulating > 5 hours of TV was associated with elevated depressive symptoms; however, this association was annulled when people engaged in > 150 minutes of LTPA/week in both sexes.	SB leisure: ↑ depressive symptoms
Felez-Nobrega et al., 2020	Spain	Observ	360 undergraduates - 44% females - average age: 20.9	SB in transportation, occupation, leisure (screen time or not) and other SB activities	Last 7-d SB questionnaire (SIT-Q-7d)	Spanish version of the State-Trait Anxiety Inventory Spanish version of the Perceived Stress Scale	Weekend total self-reported SB was related to higher trait anxiety and perceived stress levels, while total SB during the week was not. Of all SB domains, only leisure time SB (screen and non-screen based) was associated with higher trait anxiety and perceived stress.	SB leisure= ↑ anxiety and perceived stress

Abbreviations: ↑ increases; ↓ reduces; CES-D: Centre for Epidemiologic Studies Depression Scale; CG.: Control group; CIS-R: The Brazilian version of the Clinical Interview Schedule-Revised; COPSOQ: Copenhagen psychosocial work environment questionnaire; EHIS-PAQ: European Health Interview Survey – questionnaire; Exper: experimental; G1: group 1; G2: group 2; GAD-7: Generalized Anxiety Disorder Scale; GHQ: General Health Questionnaire; GPAQ: Global physical activity Questionnaire; HRQOL: health-related quality of life questionnaire; IPAQ: International Physical Activity Questionnaire; K-6: Kessler Screening Scale -psychological distress; KAPS: Kaiser Physical Activity Survey; LTPA.: leisure time physical activity; MET: Metabolic equivalent of the task; MVPA: moderate/vigorous physical activity; N/A: Not applicable; Observ.: observational; OPA.: occupational physical activity; PA.: physical activity; PHQ-9: Patient Health Questionnaire-9 items; PHQ-8: Patient Health Questionnaire-8 items; PPAQ: Pregnancy physical activity questionnaire; PSS14: Perceived Stress Scale 14; QOL.: Quality of life; SB.: sedentary behavior; SF-36.: Short Form Health Survey-36; SIT-Q-7d: Last 7-d SB questionnaire; TPA.: transport physical activity; USA: United States of America; WEMWBS: Warwick-Edinburgh Mental Welfare Scale; WHOQOL-BREF – World health organization quality of life brief questionnaire.

3.3. Risk of bias in the included studies

According to the criteria established for this review, the studies presented a medium (n=9) to low (n=17) risk of bias. More detail on the risk of bias evaluation for each study is presented in Table 3.

Criteria for assessing the risk of bias of the included studies:

1. Random selection of participants
2. Eligibility criteria for declared participants and appropriate description of the study sample.
3. Visible assessment of participation in PA (or SB), including membership in a PA program, if no direct PA (or SB) measurements were included.
4. Valid mental health assessment
5. Covariates adjusted in analyses related to PA and mental health (e.g., gender, age)
6. Power calculation reported, and the study was adequately fed to detect hypothetical relationships.

Rating: "1" - present and explicitly explained or "0" - missing or described inappropriately

Table 3: Risk assessment of bias of the studies included in the review.

Physical activity							
Author and year publishing	Criteria						
	1	**2**	**3**	**4**	**5**	**6**	**Total**
Mason et al., 2016	0	1	1	1	1	0	4/6
Sliwa et al., 2016	0	1	1	1	1	0	4/6
White et al., 2017	0	1	1	1	1	1	5/6
Jakobsen et al., 2017	1	1	1	1	1	1	6/6
Sheikh et al., 2018	0	1	1	1	1	1	5/6
Zheng et al., 2018	1	1	1	1	0	0	4/6
Fang et al., 2019	0	1	0	1	0	0	3/6
Kekäläinen et al., 2019	0	1	1	1	1	1	5/6
Siefken et al., 2019	0	1	1	1	0	1	4/6
Fernandez-Montero et al., 2020	0	1	1	1	1	1	5/6
Marques et al., 2020	0	1	1	1	1	1	5/6
Neumeier et al., 2020	1	1	0	1	0	0	3/6
Tharrey et al., 2020	0	1	1	1	1	0	4/6
Werneck et al., 2020	0	1	1	1	1	1	5/6
Changwook Kim et al., 2021	0	1	1	1	1	1	5/6
De Cocker et al., 2021	0	1	1	1	1	1	5/6
Jo et al., 2021	0	1	1	1	1	0	4/6
Schuch et al., 2021	0	1	1	1	1	1	5/6
Werneck et al., 2021	0	1	1	1	1	0	4/6

Physical activity and (or) sedentary behavior							
Atkin et al., 2012	0	1	1	1	1	1	5/6
Hamer & Stamatakis, 2014	0	1	1	1	1	1	5/6
Teychenne, 2017	0	1	1	1	1	1	5/6
Chu, et al., 2018	1	1	1	1	1	1	6/6
Edwardson et al., 2018	1	1	1	1	1	1	6/6
Felez-Nobrega et al.,2020	0	1	1	1	1	1	5/6
Werneck et al., 2019	0	1	1	1	1	1	5/6

Score: 1 and 2 points as high risk of bias, 3 and 4 points as medium risk of bias, and 5 or 6 points as low risk of bias.

3.4. Characteristics of the participants

Among the twenty-six included studies, 538,206 people were involved. Two studies were performed in several European countries, four in Brazil, four in Australia, three in England, two in Spain, and two in the United States of America. Countries that contributed with one study were Taiwan, Austria, France, Denmark, Finland, South Korea, Scotland, Norway, and Singapore. Three (11%) investigations included women from socioeconomically disadvantaged neighborhoods or immigrants, two (7.6%) included working women, eighteen (69%) investigations included both men and women, two studies (7.6%) included participants with a high level of stress/depressive symptoms, and one study (3.8%) included overweight men and women.

3.5. Summary of the results

In the experimental studies (6), compared with the control group, the reduction in occupational SB reduced anxiety at 6 and 12 months ($p=0.002$ and $p=0.004$) and increased two domains (psychological and environmental) of quality of life in the same period ($p=0.002$ and $p=0.005$) (Edwardson et al., 2018). Regarding PA, in experimental studies, LTPA increased the quality of life ($p<0.001$), reduced the level of stress at work ($p<0.005$) (Fang et al., 2019), reduced state of anxiety ($p<0.005$) and trait ($p<0.005$), and improved mental health ($p<0.005$) (Zheng et al., 2018). Furthermore, LTPA improved vitality, control and concern about pain (all, $p<0.005$) (Jakobsen et al., 2017; Zheng et al., 2018), as assessed with the Short Form Survey 36 (SF-36). In a study that assessed changes in mental health by boosting people to be more physically active on their commute to work, TPA showed positive associations with mental health in the group that became more active in commuting to work when compared with the control group. Changes were observed in four subcomponents of the SF-36 (physical functioning [$p=0.023$], mental health [$p=0.036$], vitality [$p=0.005$], and general health [p=0.004]). In addition, the participants who took a bike path (one of the ways to increase TPA in the intervention group) presented more changes in quality of life than people who used public transport and walked (Neumeier et al., 2020). Regarding OPA evaluated in the community garden, no differences were found in mental well-being compared with the control group after one year of follow-up (Tharrey et al., 2020).

Concerning longitudinal studies focusing on PA (3) (Changwook Kim et al., 2021; Sheikh et al., 2018), two studies with 9 and 13 years of follow-up found that LTPA increased psychological, emotional and social functioning and reduced psychological distress over time, but OPA and TPA increased the risk of depression after 6 years of follow-up (Teychenne et al., 2017). Conversely, leisure-time SB (watching TV) was associated with higher depressive symptoms at baseline (cross-sectionally), while mentally active SB (e.g., reading or computer use) was associated with lower depressive symptoms. However, when considering the follow-up (2 years later), there was no increase in depressive symptoms associated with any type of SB (Hamer & Stamatakis, 2014).

In cross-sectional studies (15), LTPA was significantly associated with well-being, (Mason et al., 2016), reduction of depression symptoms, anxiety, and psychological distress (Chu et al., 2018; De Cocker et al., 2021; Fernandez-Montero et al., 2020; Jo et al., 2021; Marques, Peralta, Gouveia, et al., 2020; Siefken et al., 2019; Werneck et al., 2020, 2021). The TPA was positively associated with well-being, distress reduction, and reduction of stress symptoms (De Cocker et al., 2021; Mason et al., 2016; Werneck et al., 2020) in some investigations, mainly in Europe, Australia, and Brazil (just when performed in high volume [60-89 min/week]), but it was also associated with an increase in the risk of depression among women living in socioeconomically disadvantaged neighborhoods in Australia (Teychenne et al., 2017). Leisure-time SB was negatively and significantly associated with well-being (Atkin et al., 2012), with increases in depressive symptoms, anxiety, and perceived stress (Felez-Nobrega et al., 2020; Werneck et al., 2019a), but in one investigation (Chu et al., 2018), no associations were found in this regard.

Despite the tendency toward consistency in the results of the majority of included studies, two studies with large samples presented somewhat opposite findings. Female participants from a Brazilian investigation (Werneck et al., 2020) who had a higher level of domestic OPA showed a higher prevalence of depressive symptoms compared to those with fewer OPA. Furthermore, in the same investigation, the TPA was associated with lower depressive symptoms in older participants. Overall, people categorized as active in leisure-time presented a lower prevalence of high depressive symptoms, while those considered active, based on the activity performed while at home, presented higher levels of depressive symptoms. In contrast, an investigation including a large European sample (De Cocker et al., 2021) indicated that the PA domain had no impact on the relationship between PA and the prevalence of mild, moderate, and severe depressive symptoms, highlighting that this is a topic deserving further investigation to determine why these differences exist.

4. Discussion

This systematic review seeks to analyze the association of specific PA and SB domains (i.e., leisure, work, home, transportation) and mental health/illness. Overall, the results confirm that the domain where PA and SB are enacted plays an important role in their impact on mental health. More specifically, regarding PA behavior, one important finding is that it is not always positively associated with mental health. This information is of relevance, as the current public guidelines for PA are centered on the weekly volume and intensity that must be achieved to entail health benefits, without specifying the domain in which this PA must be accumulated. PA can be distributed in different domains of human movement, that is, at work (paid or domestic), during active transportation, and during leisure-time. Our review indicates that only LTPA and TPA (depending on the sample and how it is performed) were positively associated with the main outcomes of well-being and mental health, while PA at work or at home (generally considered occupational or domestic) was associated with worse mental health. This can be partly explained not only by the context in which PA is performed but also by the role of sex or socioeconomic status. The conclusions are aligned with previous studies (Teychenne et al., 2020) indicating that to promote mental health, PA must be performed at leisure-time, prioritizing pleasurable physical activities.

Although several physiological mechanisms explain how PA plays a fundamental role in depression and mental health (F. Schuch et al., 2017; F. B. Schuch & Stubbs, 2019), apparently these mechanisms are not sufficient to contribute to well-being in all contexts. One of the possible explanations for LTPA being more strongly associated with well-being can be justified by the DRAMMA model (detachment-recovery autonomy, mastery, meaning, and affiliation) proposed by Newman, Tay & Dinner (2014). According to this theory, leisure (structural or subjective) triggers a feeling of recovery, autonomy, mastery, meaning, and affiliation, and these psychological mechanisms promote domain well-being, which would lead to improved global well-being through bottom-up theory (Newman et al., 2014). Thus, even if the total accumulated time and energy expenditure of PA were transversal to the domains, only

LTPA could emanate the psychological mechanisms associated with well-being, while in other domains, this would not be possible (Newman et al., 2014). In addition, there are physiological explanations that complement this statement. For example, OPA may have mild intensity, not enough to improve cardiorespiratory capacity or discharge only for brief moments. It could also maintain heart rate and high blood pressure for several hours during the shift/working period, maintain the isometric contraction of postural muscles in the handling of objects or loads, not have the proper recovery time, and still generate increased levels of inflammation and pain (Holtermann et al., 2012; Holtermann, Krause, van der Beek, et al., 2018), which in term have even been associated with mental health issues (Archer et al., 2014).

Although it was not part of the main purpose of this review to investigate the type of LTPA that is most effective for mental health, some studies that explored the effect of LTPA performed in groups (versus individually) indicated that in women, some aspects of quality of life, such as vitality and concern with pain, an important component of well-being), were improved by exercise in group versus individually at home. LTPA performed with the family also seemed to increase the scores of well-being in men and women (Mason et al., 2016). On the other hand, group-based PA was strongly associated with lower depressive symptoms in men but not in women with depressive symptoms (Werneck et al., 2021), and indoor group exercise was more effective in reducing depressive symptoms than outdoor activities (Siefken et al., 2019) in exercise/sports practitioners. In fact, participation in group-based exercise has been associated with higher satisfaction of basic psychological needs and self-determined exercise motivation in women (Lovell et al., 2016), which can lead to long-term adherence (Teixeira et al., 2012) and improve well-being.

Regarding TPA, the overall results pointed to an association with better mental health and quality of life and lower rates of depression in European countries; however, in a study conducted in South America (Werneck et al., 2020), fewer depressive symptoms were found in those who took more active trips, but only among older adults. Another study found that in women living in socioeconomically disadvantaged neighborhoods in Australia (Teychenne et al., 2017), TPA was associated with a higher risk of depression. A previous meta-analysis indicated that the relationship between active commuting and depression is inconsistent (Marques, Peralta, Henriques-Neto, et al., 2020), probably due to different geographical areas and social contexts that involve engaging in active transport. It is recognized that the quality of the built environment (infrastructure, security, traffic, pedestrian and cycling areas, etc.) is an important determinant of TPA practice (Smith et al., 2017). Thus, given the difficulties of some countries to adapt to the demands of active transportation properly (following the United Nations agenda for sustainable development), the recommendation for the population to increase PA as a way of transport/commuting needs to be taken carefully, as it is probably more successful in developed countries (where the context allows for the intention to happen, alongside well-being) and may not translate to reality in some countries/cities, as the context does not allow for the behavioral modification to generate well-being (e.g., due to pollution, safety reasons, and inexistent adequate paths).

OPA is an understudied domain, with few studies; nonetheless, OPA is often related to impaired health. Two studies (Sliwa et al., 2016; Werneck et al., 2020) are in agreement with what has been described in the literature as the "paradox of PA" (Holtermann et al., 2012), which questions the health benefits of PA depending on the domain in which it is performed. In one of these investigations (Sliwa et al., 2016), the survey included only Latin women and immigrants, and the chances of reporting high depressive symptoms were 2 times higher for those in the highest quartile of OPA than for those in the lowest quartile. Another investigation with Brazilians (Werneck et al., 2020) also indicated that women with more OPA (at work or at home) were associated with more depressive symptoms, and in this country, OPA is responsible for 75% of total PA, while leisure-time was responsible for only 17%. On the other hand, in the investigation with 261,121 Europeans (De Cocker et al., 2021), performing any level of PA (including OPA) was associated with a lower prevalence of mild, moderate, moderate-severe, and severe depressive symptoms, indicating that depending on the country, context, sex, or socioeconomic status, there may be different results for the role of PA in mental health (Fluharty et al., 2020; Sfm et al., 2020; Strain et al., 2020), stressing the need for having these variables considered.

This review is in agreement with previous meta-analyses, pointing out that the domain in which PA occurs influences mental health and the prevention of mental illness, with LTPA being the domain that seems to be more beneficial to well-being (White et al., 2017; Wiese et al., 2018). We consider this information of particular importance, given that a Cochrane review (Posadzki et al., 2020) on the efficacy of PA in 54 different health conditions (e.g., mortality, cancer, physical and cognitive decline, glycemic control) indicated that the magnitude and effect size were higher among patients with mental health conditions. Therefore, it would be of critical importance that health systems throughout the globe (especially those related to mental health) not only actively refer patients to the practice of regular PA but also specify the domain where the evidence is stronger (i.e., LTPA).

In what concerns to SB domains, fewer studies were found, highlighting that this is an understudied arena, precluding comprehensive conclusions. Nonetheless, from the studies included, it was possible to determine that in adults, the accumulation of >5 hours/day of SB during leisure-time is harmful to mental health, specifically in terms of depressive symptoms and psychological distress (Werneck et al., 2019b). Moreover, when sensor-based measures of SB were used, the association with mental health was more evident, which has also been reported in other investigations (Wang et al., 2019). On the bright side, compliance with PA recommendations, especially when it is of greater intensity, can be protective or even eliminate the negative associations between SB and mental health (Werneck et al., 2019b). Allowing people to be physically active while reducing SB can prevent mental illness and improve their well-being. However, this still seems to be a privilege of people from the highest socioeconomic groups (Stalsberg & Pedersen, 2018). One of the investigations included in this review analyzed the reduction in occupational SB using standing desks (i.e., adjustable tables allowing standing workplace) and identified a reduction in anxiety and an increase in quality of life in employees over the course of one year (Edwardson et al., 2018). In fact, this has been a promising strategy for reducing SB (Neuhaus et al., 2014) in environments where adults spend most of their time, thus reallocating sitting time to standing, which increases PA. However, none of the three investigations included in this review found a relationship between occupational SB and mental health/disease measures. One of the explanations can be that SB should be analyzed not only considering the domain but also the type of SB within the domain (e.g., mentally active - reading or mentally passive - watching TV) (Hallgren et al., 2020), with mentally passive SB being more associated with the risk of depression than mentally active SB (Huang et al., 2020). The plausible mechanisms for these differences are still speculative but may include psychosocial factors (e.g., social isolation and lack of social relations) (Hallgren et al., 2020).

In sum, although the increase in PA and the reduction of SB should become, rather than "recommended", mandatory in the global agenda to support the well-being and mental health of people (Stamatakis & Bull, 2020), the domain in which these modifications occur must be better investigated to suit the distinct realities.

5. Limitations

One of the main limitations of the present investigation is that most studies were observational (77%) and therefore do not allow us to establish causality. In addition, 42% (11/26) of the included studies only evaluated one domain of PA (LTPA), indicating the need for future investigations considering other SB/PA domains. Excluding the experimental studies (6) and those that used objective measures, most investigations used questionnaires to assess both PA and SB, which suffers from memory bias of the interviewees and entails subjectivity, especially for SB.

The major strength of this systematic review pertains to the inclusion of SB and not only PA domains. To the authors' knowledge, there is no systematic review that encompassed several domains of both PA and SB, thus representing novelty to this research field. Additionally, the reporting of both mental health and illness outcomes to capture a variety of studies and participants in the covered articles needs to be highlighted. Indeed, and given that there is a need for more research involving middle-and low-income countries, we have managed to capture a wide range of countries with different socioeconomic statuses, thus representing an important strength.

6. Implications for practice

It is expected that this work can contribute to scientific knowledge regarding the factors related to PA and SB that influence people's mental health. In addition, it is intended to better understand the role of each domain of PA and SB in mental health and lack thereof so that public health recommendations can be increasingly accurate considering the cultural, social, and health particularities of each country. The findings of this systematic review showed that the type of measures used to assess PA and SB (objective and subjective) may change their relationships with mental health. When it comes to the domains of both behaviors, the appropriate use of questionnaires where it is possible to capture the contexts would be important. However, they are prone to measurement error, as well as underreported periods of SB, which has been attributed to social desirability and non-recall of some types of PA (for example, TPA) (Adams et al., 2005). On the other hand, although the objective methods entail less error and bias, alone they do not allow to assess the contextual domains, thus, it is important that future studies use both types of measures together to capture both the accurate amount of PA and SB, as well as the domain in which these behaviors occur.

7. Conclusion

Although an increase in PA and a reduction in SB are recommended by the main health organizations, as one of the main ways to improve mental health and avoid mental illness, we conclude that the relationship between these physical behaviors and mental health may vary according to the domain in which both behaviors are accumulated. Current physical movement recommendations focus on weekly volume and intensity for PA, but based on the information gathered, the focus should be on LTPA, as it seems to be the most effective domain for improving mental health. Furthermore, leisure-time SB seems to be the one representing the most harm to mental health, especially among inactive people, thus emphasizing that health systems (especially those related to mental health) should not only refer patients to the practice of regular PA, as they must specify the domain in which these behaviors should occur and the type of behavior within the domain.

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Chapter IV

Study 2: Correlates of life satisfaction

A felicidade consiste numa certa maneira de viver, no meio que circunda o homem, nos costumes e nas instituições adotadas pela comunidade à qual pertence.

Aristóteles

Chapter IV

An analysis of health-related correlates of life satisfaction in adults in a university environment. Is physical activity always good? *[2]

Abstract

As it is a comprehensive concept, life satisfaction (LS) has several correlates that can improve or harm it; however, few investigations focus on modifiable health behaviors as correlates of life satisfaction in adults. This was a cross-sectional investigation, with data from 311 adults (average age 35.3 [± 13.4]). Age, weight and height, physical activity (PA) and sedentary behavior (SB) by domain, diet, sleep, chronic disease, socioeconomic status, and smoking history were self-reported. Satisfaction with work/course, personal relationships, and free time were assessed, and used as an indicator of general life satisfaction. A linear regression model was used to identify correlates associated with general life satisfaction. The results indicated that between all putative indicators included in the model, negative correlates of life satisfaction were SB in the occupational domain (β=-0.002 for each minute spent seated; p=<.001), a low (vs high) perceived financial situation (β=-0.939; p=0.009) and performing incidental PA (vs during leisure-time) (β=-0.624; p=0.020), on the other hand, higher age emerged as a positive correlate (β = 0.034; p = <.001). Thus, data from this study reinforce the necessity for governments and politicians to keep boosting their population PA levels and reducing the SB, allowing individuals to have more leisure time and perform this PA outside their jobs, domestic tasks or commuting. Besides that, although SB is harmful for health, those who accumulate this behavior in their occupational times seem to reduce their life satisfaction, as do those who find themselves in a compromised financial situation.

Key words: domain-specific; physical activity, correlates; well-being; life satisfaction;

[2] Teno, S.C., Silva, M.N., Carraça, E.V., Júdice, P.B. An analysis of health-related correlates of life satisfaction in adults in a university environment. Is physical activity always good? Submitted for publication.

1. Introduction

People's well-being has been a critical component of concern from major international entities dedicated to improving health, quality of life, and population development (*Who We Are*, 2023; The World Health Organization, 1995; United Nations Development Programme, 2023), given it is essential for creating a healthy and productive society. Thus, many countries and entities apply objective measures of well-being, such as income, literacy, and life expectancy, to indicate how is the life of their citizens; However, these social indicators may not fully capture an individual's perceived quality of life (Boarini & D'Ercole, 2013) and subjective measures now are used together to understand how the people assessed their lives.

Subjective well-being, i.e., the way someone evaluates his or her life, including life and material satisfaction, lack of depression and anxiety, and positive mood and emotions (Diener, 1984; Diener et al., 1999), has been a common way to assess the well-being and is composed of a cognitive dimension, in which there is an evaluative judgment, usually expressed in terms of life satisfaction (LS) – in global or specific terms (for example, satisfaction on work or personal relationship), and an emotional dimension, positive or negative – also expressed in global terms or specific through emotions (Diener et al., 1999; Galinha & Pais-Ribeiro, 2005). From these dimensions, the LS is the dominant dimension studied, in addiction, is an essential global indicator of individual and societal well-being, is considered a longevity predictor (Martela et al., 2024) and has been investigated mainly in public health and psychology (Das et al., 2020; OECD, 2020).

As it is a comprehensive concept, several correlates can improve or harm LS. For example, the main correlates often cited are standard of living, family income, and social support (Capone et al., 2021; Choi et al., 2023; Jarden et al., 2022; Park et al., 2019), i.e., demographic, social, and psychological correlates. However, health behaviors and functioning indicators are also important correlates (Das et al., 2020) that can be subject of faster intervention in academic environments.

Physical activity (PA), sedentary behavior (SB), sleep, and diet comprise our 24 hours of the day and could, compared to social correlates, could be modified in the shorter term. SB, i.e., a series of activities in a sitting or reclining posture with low energy expenditure ($\leq$ 1.5 metabolic equivalents [MET]) while awake (Tremblay et al., 2017), is a behavior that matches more than 60% of the waking time of adults in developed countries (Santos et al., 2018) and has been often negatively associated with low LS. For example, in a investigation with 12,492 university students (median age 20 years) from 24 countries, those that had higher SB (4 to < 8 h and ≥ 8 h), was associated with poorer LS (β = −0.21, confidence interval (CI): −0.27 to −0.14) (Pengpid & Peltzer, 2019). In addition, in an experimental investigation inducing SB, the reduction of PA restricted to 5000 or fewer daily steps per day, significantly reduced the levels of LS in active young adults (18-35 years old), compared to the group that maintained regular PA for one week (Edwards & Loprinzi, 2017), however, the most investigations do not identify if all contexts/domains (leisure, occupational or commuting) of SB has the same association with LS. Recent studies that differentiate the domains, indicated that SB in leisure contexts is significatively associated with depressive symptoms anxiety, and stress in adults (Alansare, 2024), what can influence LS, however, few studies have a positive approach to this theme. Furthermore, the importance of complying with PA recommendations to improve health and LS has been established at all stages of life (An et al., 2020; Pedersen & Saltin, 2015); however, most PA recommendations has been made based on leisure-time PA (Quinn & Gibbs, 2023), but most of the PA is performed in occupational settings (work/family – 52% of total PA) or for transport – 36% of total PA in 104 countries (Strain et al., 2020) - called of incidental PA (Strath et al., 2013; Tremblay et al., 2007) - and not in the leisure-time (4% of total PA), and the relation of PA performed in incidental contexts needs to be clarified regarding LS (Pedišić et al., 2014). Besides that, other behaviors, often harmed in academic environments, like sleep (Becker et al., 2018), diet (Yun et al., 2018), smoking history, and presence of disease will be investigated.

Finally, Portugal has one of the lowest LS indices according to the Organization for Economic Co-operation and Development (OECD), with an average score of 5.8 (index ranging from 0 to 10), which is lower than the average OCDE countries of 6.7. These outcomes justify a deeper investigation of the main correlates of LS, identifying the factors that can improve or harm it in a sample of adults from an academic environment.

2. Method

2.1. Design

This study was part of a cross-sectional investigation developed and implemented at the largest private university in Portugal. Throughout November 2021, participants were recruited online via convenience sampling, via email, and via university social networks with a link to the questionnaire (Qualtrics platform). The LusófonAtiva project aimed to design and implement a digital system for monitoring health behaviors linked to healthy lifestyles in the university context (ILIND/F+/EI/02/2020).

2.2. Study population

The present study included all students, teachers, and employees from the university campus who volunteered to participate, with no predefined exclusion criteria. Our analysis included 311 adult participants (18–64 years old) from the university campus who volunteered to participate and completed the questionnaire based on the main variables of the current study.

2.3. Ethics approval and consent to participate

The protocol complies with legislation, international conventions, and ethical research practices. Participation was entirely voluntary, and ethical rules for research on humans assured anonymity and confidentiality. All participants provided informed consent before completing the questionnaire, and the LusófonAtiva project obtained ethical approval from the institutional ethics committee on January 20, 2021.

2.4. Measures

Demographic data: Information on age, sex, financial status, and occupation (employees, teachers, and students) was self-reported. Financial status was assessed through the personal perception of the current financial situation with the question, "How do you classify your current financial situation?" "Difficult" and "Very difficult" [classified as “low financial perception”; "sufficient to pay the bills" [classified as “medium financial perception”], "comfortable" and "very comfortable" [classified as “high financial perception”]; and was used as a categorical variable. Age was used as a continuous variable.

Life satisfaction: Participants were presented with scales ranging from 0 “not satisfied” to 10 “completely satisfied” about work/course, personal relationships, and free time to perform what they liked, according to recent guidelines about well-being measures (VanderWeele et al., 2020). Then, it was calculated as the mean of these three items, with higher values indicating greater LS, and was used as a continuous variable called general satisfaction with life (GSL).

Physical activity was assessed with the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). The IPAQ was chosen because it is an internationally validated questionnaire tested in several countries and has demonstrated acceptable reliability and validity, especially in urban samples (Craig et al., 2003). The cutoff point for being considered physically active or inactive was established by current WHO recommendations (Bull et al., 2020; Thivel et al., 2018), i.e., “meeting the recommended PA goal" (≥150 min/week of moderate PA or ≥75 vigorous) or "not meeting the recommended PA" (<150 min/week of PA moderate or <75 vigorous). Since we would like to know about the domain where the PA was performed, we asked, "What kind of physical activities do you usually do?" with several response options ranging from sports (team or individual sports) and physical exercises (running, dancing, strength training, group classes) – classified as 'active in leisure PA' and an option "I do not practice structured PA," to classify them as 'active in incidental PA.'

Sedentary behavior was also assessed with the IPAQ by asking about the duration (the average time in hours per day) that the person spends sitting during a weekday and a weekend day. In addition, to capture the domains of SB, questions were created regarding the time participants usually spent sitting at work/school (occupational), on transport, or in their leisure time. The questions were: "On average, how much time do you usually spend sitting at study/work per day?" "On average, how much time do you usually spend sitting making a hobby, watching TV, using the computer/tablet/cell phone for leisure per day?" and "On average, how much time do you spend sitting on public/private transport per day?". The answers were weighed by day (min/day) through the weighted arithmetic average of the responses of the time spent in sedentary behavior on weekdays and weekend days, and the time spent in each domain was used as a continuous variable. The domains considered are the same as PA (i.e., occupational time [work or study], leisure time, and transportation).

Body mass index (BMI): BMI was calculated as weight/height^2 (kg/m^2) according to self-reported body weight and height and was used as a continuous variable.

Smoking history: It was assessed through the question "Have you ever smoked?" with three response options: "Never smoked," "I have smoked, but I do not currently smoke," and "Currently smoking"). These options were used as categorical variables.

Sleep duration: Sleep duration was assessed by the following questions: "In a typical week, what time do you usually lie down at night?" and "In a typical week, what time do you usually get up in the morning?". The results (in hours and minutes) were classified as low (less than 6 hours and 59 minutes per night), adequate (7–9 hours per night), or high (more than 9 hours and 1 minute per night) based on previous recommendations for an adequate amount of sleep (Ross et al., 2020).

Presence of chronic disease: Participants were assessed by asking the question, "Do you have any chronic illness (physical or psychological) or disability diagnosed by a doctor?" The response option was "yes or no," which was used as a dichotomous variable.

Adherence to the Mediterranean diet: This was assessed using an 11-item original questionnaire assessing adherence to the Mediterranean diet (Panagiotakos et al., 2007), in which the participants reported the weekly consumption of 9 food groups (i.e., 1) non-refined cereals, 2) fruits, 3) vegetables, 4) legumes, 5) potatoes, 6) fish, 7) meat and meat products, 8) poultry, and 9) full-fat dairy products, including cheese), as well as olive oil use in cooking and alcoholic beverage intake, based on the principles of the traditional Mediterranean Diet. Each response for an item had a scale of 0 to 5 (never, rare, frequent, very frequent, weekly, and daily consumption) or on a reverse scale (i.e., from 5 to 0) for food groups that were presumed away from the Mediterranean Diet. Thus, a composite score was calculated and used as a continuous variable, with higher scores representing greater adherence to this pattern, ranging from 0 to 55.

2.5. Statistical analysis

The data analyses were performed using the software Jamovi project (2021), version 2.2, and the significance level was kept at 5%. We only included data from 311 participants who completed the questionnaire considering the main variables of the current study (GLS). Sample characteristics are presented as means and standard deviations for the continuous variables and frequencies for the categorical variables. A linear regression model was used to identify the correlates associated with GLS. Collinearity diagnostic tests were performed for all independent variables to comply with the assumptions of the linear regression analysis. Thus, the variance inflation factor (VIF) values allowed the inclusion of all variables in the model, as all values were less than 1.5 on a scale of 1-5 (Akinwande et al., 2015). The normality of the data was verified by the Shapiro–Wilk test. The odds ratio and 95% confidence intervals were calculated. It is essential to highlight that the variables included in the model were chosen according to previous studies concerning the predictors/correlates of well-being (Das et al., 2020) and based on the variables included in the main project that hosted this research piece. The model explained 24% of the variance in GSL (R^2=0.24).

3. Results

3.1. Overall results

The total sample (n=311) consisted of 50 employees (16.1%), 75 teachers (24.1%), and 186 students (59.8%). Table 1 describes the sample's characterization, and Table 2 depicts the putative correlates of general satisfaction with life.

Table 1. Characterization of the sample

Variables	Mean	Standard deviation	% of the sample
Continuous Variables			
Age (years)	35.3	± 13.4	
Body mass index (kg/m^2)	24.6	± 5.0	
Sedentary behavior – Domains (min/day)			
Leisure-time	204.7	± 134.9	
Transport	72.6	± 57.5	
Occupational	414.8	± 185.4	
Adherence to Mediterranean Diet (0 to 55 pts)	28.5	± 4.5	
GSL (mean of 3 items – 0 to 10 points)	6.0	± 1.9	
Categorical variables			
Sex			
Male			37.9
Female			62.1
Sleep duration			
Low			21.0
Adequate			62.1
High			16.8
Chronic disease			
Yes			18.2
Not			81.8
Financial situation perceived			
Low			15.4
Medium			54.0
High			30.5
Smoking history			
Never smoked			59.5
Have smoked, but currently do not			23.8
Currently smoking			16.7
Meet the physical activity recommendations			
Yes			66.1
No			33.9
Perform physical activity by			
Incidental physical activity			45.0
Leisure physical activity			55.0

Abbreviations: GSL, general satisfaction with life.

Table 2: Putative Correlates of general life satisfaction

Variables inserted in the model	OR (95% CI)	P value	Estimate (β)
Age (years)	**0.232 (0.099 – 0.365)**	**<.001**	**0.034**
Body mass index (kg/m^2)	0.041 (-0.755 - 0.158)	0.485	0.016
Leisure-time sedentary behavior (min/day)	0.111 (-0.021 – 0.244)	0.101	0.001
Transport sedentary (min/day)	-0.035 (-0.158 – 0.086)	0.565	-0.001
Occupational sedentary behavior (min/day)	**-0.205 (-0.322 – -0.087)**	**<.001**	**-0.002**
Adherence to Mediterranean Diet (0 to 55 pts)	0.111 (-0.013 – 0.236)	0.079	0.049
Sleep duration (h)	Compared to “adequate”		
Low	0.261 (-0.038 – 0.560)	0.087	0.518
High	0.073 (-0.248 – 0.394)	0.654	0.145
Chronic disease	Compared to “no”		
Yes	-0.169 (-0.463 – 0.132)	0.274	-0.329
Financial situation perceived	Compared to “high”		
Low	**-0.473 (-0.827 – -0.119)**	**0.009**	**-0.939**
Medium	-0.243 (-0.497 – 0.010)	0.060	-0.483
Smoking history	Compared to “never smoked”		
Have smoked, but currently do not	-0.192 (-0.470 – 0.084)	0.172	-0.382
Currently smoking	-0.076 (-0.402 – 0.249)	0.646	-0.151
Meet the physical activity recommendations	Compared to “yes”		
No	-0.171 (-0.440 – -0.097)	0.210	-0.340
Perform physical activity by	Compared to “leisure-time”		
Incidental physical activity	**-0.314 (-0.578 – -0.050)**	**0.020**	**-0.624**

Bold values are statically significative.

Our data indicated that, among the factors included in the model, several negative correlates of GSL were identified, namely SB in the occupational domain (β = -0.002 for each minute spent seated; p<.001), the perceived low (vs high) financial situation (β = -0.939; p=0.009) and performing incidental (vs leisure-time) PA (β = -0.624; p=0.020). On the other hand, age was identified as a positive correlate of GLS (β = 0.034; p=<.001).

4. Discussion

Previous studies suggested that socioeconomic factors can be important correlates of LS (Capone et al., 2021; Choi et al., 2023; Jarden et al., 2022; Park et al., 2019). However, we aimed to find health-related correlates that harm or improve the LS in a sample from an academic environment. Our findings indicated that those who spent more time sitting in the occupational domain (working or studying), those who performed incidental PA, instead of being active through planned PA in leisure-time, and those who perceived their financial situation as low (vs high) were less likely to be satisfied with life. On the other hand, age was positively related to GLS, indicating that as age advances, LS increases.

Regarding age, our findings complement the investigations that suggest that age has a positive association with LS at least until 65-70 years old (Baird et al., 2010); however, our sample is 30 years old on average, what becomes our comparison with more extensive studies uncertainty. In addition, in this age range, the changes in socioeconomic circumstances promoted by academic conquest (for example, new work opportunities) can positively impact the evaluation of life, besides being relatively far from the physical decline of aging, which could reduce LS (Das et al., 2020).

Sitting time in the occupational domain (i.e., at work or while studying) has been associated with several health problems, such as back pain (Kallings et al., 2021), impaired mental health in adults (Rebar et al., 2014), lower job satisfaction and greater fatigue (Rosenkranz et al., 2020), all of which are factors that can reduce LS (McNamee & Mendolia, 2014; Unanue et al., 2017). However, it is still unclear if this SB (occupational) domain is the most harmful to LS and whether it can be mediated for other factors such as exposure time or context. For example, data from the Swedish Health Profile Assessment (HPA) (N=23,644; 57% male), a health assessment offered to employees working for companies or organizations connected to healthcare services, indicated that those who spend more than 75% of the time sitting at work (compared to whom responded rarely sitting), reported more frequent symptoms of depression/anxiety, but who spend more than 50% of their leisure-time in sedentary pursuits also experienced the same symptoms (Hallgren et al., 2020). A scoping review (Sui et al., 2021) found that screen time (normally performed sitting) was negatively associated with LS in 7 studies out 11 included. However, screen time can be performed for leisure, work, or study, again making it difficult to compare. One of the reasons that SB in the occupational domain can relate to lower LS is that, it takes time away from PA, which is responsible for the prevention and treatment of diseases or conditions that impair LS, such as depression and anxiety (Schuch & Stubbs, 2019). Furthermore, the stressful factors promoted by occupational environmental (work or studying), can be amplified, since SB itself "per se" has been associated with greater reactivity to stress (Chauntry et al., 2022). Thus, there are preliminary indications that the domain of SB can be associated with a reduction of LS. Still, most investigations are observational and focus on total SB rather than context-specific, making it difficult to confirm our assumptions.

Incidental PA has been described as any activity that is part of one's daily living that is not done with the purpose of recreation or health (Care, 2021; Strath et al., 2013; Tremblay et al., 2007), and leisure PA as all behaviors related to PA that people perform in their free time (Steinbach & Graf, 2008). In this investigation, incidental PA was a negative correlate of GSL compared to PA practice in leisure. PA can be performed in the leisure time (e.g., walking, cycling, dancing, doing sports, exercising in the gym), as well as part of the work setting (e.g., lifting, carrying, cleaning, washing), or while commuting (i.e., biking, walking – here, as they reflect PA included in daily life, neither planned nor structured). However, recent investigations have also shown that the domain/context of PA (as well SB) can mediate the relation between PA and well-being (Vella et al., 2023), with leisure-time PA being the most positively associated with well-being measures (Teno et al., 2024). One of the possible explanations for why incidental PA was not associated with well-being can be justified by the DRAMMA model (detachment-recovery autonomy, mastery, meaning, and affiliation) proposed by Newman, Tay, and Dinner (Newman et al., 2014). According to this theory, leisure (structural or subjective) triggers feelings of recovery, autonomy, mastery, meaning, and affiliation, and these psychological mechanisms promote domain well-being, which leads to improved global well-being through bottom-up theory. Thus, even if the total accumulated time and energy expenditure of incidental PA were the same, only PA in the leisure context could emanate the psychological mechanisms associated with well-being. At the same time, this would not be possible in other domains. This phenomenon has also been described in the literature as "the physical activity paradox," which argues that not all PA is good for health; in this case, our data may corroborate this theory (Gupta et al., 2020; Holtermann et al., 2012) and recommend that people must prioritize leisure-time PA when the aim is improve well-being.

This was perhaps the most exciting finding, reinforcing the necessity for governments and politicians to keep boosting their population PA levels, but with strategies allowing individuals to have more leisure time and perform this PA outside their jobs, domestic task or commuting. Although active transport (walking and cycling to work/school) is recommended for contributing to climate changes, for example: sustainable development goal (SDG) (health behaviors - SDG 3, education – SDG 4, reducing inequalities - SDG 10, sustainable cities - SDG 12, sustainable consumption - SDG 11), as well as the economy of cities (Nigg & Nigg, 2021; Pérez et al., 2017), investigations that presented positive results for well-being measures by active transport were in people who experienced changes in some specific built environment attributes (like cycle paths and more walkability), and for short commute times (Clark et al., 2020; Wang et al., 2023), thus, it may be in the future, when the cities are able to adapt to solutions for more active transport, and it reaches the entire population (not just in some areas), we will be able to confirm whether this form of PA can have significant impact on LS and well-being.

Socioeconomic status (i.e., perceived financial situation) has been a correlate frequently cited in the literature. It is considered a factor that does not necessarily increase LS, but that seems to buffer the impact of negative emotions, such as worry, mainly at extreme levels of poverty; however, once basic needs are met (food, dwelling, health, and secure), the influence wanes (Das et al., 2020). Portugal is among Europe's most unequal and poorest countries (*Inequality - OECD*, 2023)' and difficulties and concerns about life conditions (an evaluative aspect of subjective well-being) can explain this negative relation between socioeconomic status and GLS. In fact, between the main theories of well-being, those evaluative and of fulfillment and engagement argue that LS would be achieved through a mental comparison between an individual's life, conditions, or circumstances with a specific goal or subjective pattern. Thus, when personal conditions do not reach this standard, this can result in lower LS and vice versa (Das et al., 2020).

Interestingly, other common health measures such as sleep, chronic diseases, diet, or meeting the recommended PA guidelines were not found to be associated with GLS. This suggests that in an academic setting where the majority of individuals are young adults with an average age of 35, these factors may not be as crucial since individuals are relatively healthy. For instance, only 18% of the participants reported having a chronic disease.

5. Strength and limitations

This study has several limitations. Questionnaire-based measures are prone to measurement error, and participants in our study may have overreported their levels of PA, as well as underreported periods of SB, which has been attributed to social desirability and non-recall of some types of PA (Adams et al., 2005). In addition, because of the cross-sectional nature of the data, causality cannot be inferred. More comprehensive questionnaires should be used in future analyses to describe better the domains in which PAs accumulate. The major strength of this study are the diversity of variables assessed and the innovative approach the exploration the domains of PA and SB, which is in line with recent recommendations (Quinn & Gibbs, 2023).

6. Conclusion

The data from this study reinforce the necessity for governments and politicians to keep boosting their population PA levels and reducing the SB, but with strategies allowing individuals to have more leisure time and perform this PA outside their jobs, domestic tasks or commuting. Besides that, although SB is harmful for health, those who accumulate this behavior in their occupational times seem to have more chances of reducing their life satisfaction, as do those who find themselves in a compromised financial situation. On the other hand, as the age advances, in a young adult's sample, LS increases.

6.1. Future directions

Our recommendation for improving well-being is partially in line with the main health entities for the practice of PA and reducing SB; however, we believe that PA should be prioritized in the leisure context and that people must target a reduction of SB in the occupational context. The strategies for both could be based on the already known 4-day working week (or reduction working hours) implemented by several countries as a pilot study (*Countries with a 4 Day Work Week*, 2024). In addition to benefits such as reduced costs, fewer health problems, and increased productivity levels, early research has indicated that employees report lower levels of stress, improvement of sleep habits, and better working life quality (Voglino et al., 2022), and we can argue that with more leisure-time, people can choose more active ways to spend their free time. However, additional research is needed to verify the applicability of these findings to diverse business models, and if people would be more active with more free time. Unfortunately, the only systematic review that verified the impact of the reduction of working hours on health did not find evidence that would be associated with an increase in PA (Voglino et al., 2022). However, we believe that this could be a promising strategy in the future, given that 1) there is few studies assessing the relation of reduction of working hours with PA (in the review above cited were three investigations), 2) the few published studies were in Scandinavian countries, traditionally known for placing a high value on work-life balance, more free-time for leisure and better income situation (Eurostat, 2024). Furthermore, we argue that PA programs must be more accessible for all people, regardless of their social class (i.e., not only private spaces for PA practice). Finally, we also argue that, according to Diener & Seligman (Diener & Seligman, 2004) as long as people do not have enough money to satisfy their basic needs and fulfill their main goals, the search for well-being will be harmed.

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Chapter V

Study 3: Domains of physical activity

Todas as vitórias ocultam uma abdicação.

Simone de Beauvoir

Chapter V

Leisure-Time vs. Incidental Physical Activity Benefits Health-related Quality of Life and Adherence to Mediterranean Diet in Adults. *[3]

Abstract

Investigations only considered leisure-time physical activity to recommend the practice of physical activity, raising doubt about whether who performed in other contexts (for example, at work or commuting, i.e., incidental physical activity) can entail the same benefit. Thus, we divided those participants who attained physical activity recommendations proposal by World Health Organization into two groups: 1) leisure-time and 2) incidental PA and then, we tested differences between groups to identify a more salutogenic profile, and to investigate differences by sex at birth. We collected demographic and health data, physical activity, sedentary behavior, sleep, adherence to the Mediterranean diet, life satisfaction and psychological well-being, and health-related quality of life from 378 adults in an academic environment. The results indicated that those who were active in their leisure-time spent less time in leisure-time sedentary behavior ($p=0.019$), performed more physical activity of vigorous intensity ($p<.001$), had greater energy expenditure per week ($p<0.001$), higher adherence to the Mediterranean diet ($p=0.017$), and scored better in the physical component of health-related quality of life ($p=0.010$). However, in the analysis by sex, the advantages of being active in leisure-time changed considerably. Thus, although the main health entities recommend the widespread practice of physical activity, our findings suggest that one performed in the leisure-time might be associated with a healthier profile when compared to incidental physical activity; a pattern that changes according to sex.

Key words: physical activity; sedentary behavior; quality of life; well-being; mediterranean diet

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1. Introduction

The World Health Organization (WHO) recommends the practice of 150–300 min of moderate intensity physical activity (PA) per week, 75–150 min of vigorous intensity PA per week, or an equivalent combination (Bull et al., 2020) for benefits in health. The benefits include a lower risk of cardiovascular disease, hypertension, obesity, diabetes, and breast/colon cancer (Pedersen & Saltin, 2015). In addition, being physically active (i.e., meeting PA recommendations) (Thivel et al., 2018) and having improved health-related quality of life and well-being (Anokye et al., 2012; Marquez et al., 2020) are positively associated with adherence to a Mediterranean diet (Tárraga López et al., 2022) and sleep quality (Alnawwar et al., 2023; Kredlow et al., 2015) and negatively associated with sedentary behavior (Mansoubi et al., 2014) and tobacco consumption (Villanueva-Blasco et al., 2021), indicating a healthier profile that can avoid the burden on the health system and prevent early mortality.

However, global progress to increase PA has been slow, unequal, and unsatisfactory (*Global status report on physical activity 2022*, 2022). According to the WHO (2022), more than 80% of adolescents and 27% of adults do not meet the WHO's recommended levels of PA worldwide. This not only affects individuals over their life course but also places a financial burden on health services and society as a whole. Globally, almost 500 million new cases of preventable noncommunicable diseases will occur between 2020 and 2030, incurring treatment costs of just over US$ 300 billion or approximately US$ 27 billion annually, if there is no change in the current prevalence of PA. Thus, the WHO claims that any kind of PA can provide health benefits, i.e., people can be active in leisure-time (e.g., walking, cycling, dancing, doing sports, exercise in gym), but also as part of their work (e.g., lifting, carrying, cleaning washing – occupational PA), or while commuting (i.e., biking, walking - transportation PA).

Leisure-time PA (LTPA) refers to all behaviors related to PA that people perform in their free time (Steinbach & Graf, 2008). Thus, there is a distinction between LTPA and PA practiced in the context of paid work, in daily tasks, or for transport. Incidental PA (IPA) has been described as any activity that is part of one's daily living that is not done with the purpose of recreation or health and requires no sacrifice of discretionary time (Care, 2021; Strath et al., 2013; Tremblay et al., 2007) (for example, for transport, in housework, or at paid work). However, recent studies have called attention for the importance of the domain (or context) of PA and its relationship with public health, because most investigations that lead us to create PA recommendations are based a) mainly on LTPA; and b) on questionnaires that do not appropriately assess incidental PA and underestimate total PA. Regarding to mental health, PA has been indicated as a prevention and treatment tool for mental conditions, and recent reviews indicate that factors such as type of activity, delivery (e.g., supervised or non-supervised), and the social environment (e.g., individually *vs* groups), are important determinants of mental health benefits (Vella et al., 2023), increasing concern about the context or the domains where PA occurs. Also, for each domain, there are ethnic, racial, sex, and socioeconomic disparities that must be taken into consideration by the scientific community (Quinn & Gibbs, 2023).

In an investigation including adults from 104 countries with data from 2002 to 2019 (Strain et al., 2020), the domains in which people accumulated moderate to vigorous PA (MVPA) indicated that most MVPA is accumulated as occupational PA (52%), followed by transportation (36%), and LTPA, which was responsible for only 12% of the total weekly MVPA. In low-income countries, LTPA accounted for only 4% of weekly MVPA time, while in the occupational domain accounted for 57%, and among women, transport-related PA was higher than in men. Another investigation, with data from 2,649 participants (20-75 y; 50% female), indicated that most MVPA is accumulated during work (50% of total MVPA; 1.2 h/d) and home-related activities (28% of total MVPA; 0.7 h/d). Participants reported less MVPA in leisure-time (15%; 0.4 h/d) and even less MVPA in transport (2%; <0.1 h/d). In the same study, men performed more MVPA than women (2.9 hours/day *vs* 2.1 hours/day; $p<0.01$), mainly driven by leisure and occupational PA (Saint-Maurice et al., 2021).

Based on the abovementioned, we consider that the domain in which PA exists can be of relevance for health outcomes, thus the aim of this investigation was to assess the differences in health indicators between adults who attain PA recommendations through leisure-time PA versus those who achieve it through IPA, and to investigate these differences by sexes at birth.

2. Method

This investigation was conducted according to the STROBE guidelines (Elm et al., 2007).

2.1. Design and setting

This is a cross-sectional investigation with data from the LusófonAtiva project that aimed to design and implement a digital system for monitoring physical behaviors linked to healthy lifestyles in the university context (ILIND/F+/EI/02/2020). This study was developed and implemented at the largest private university in Portugal. At the beginning of the study, participants were recruited online throughout November 2021, via convenience sampling. Invitations were sent via email and university social networks, including a link to the questionnaire (via the Qualtrics platform).

2.2. Participants

All students, teachers, and employees from the university campus who volunteered to participate were included in the present study, with no predefined exclusion criteria. For these analyses, data from 378 participants adults (18 – 64 years old) who completed the questionnaire considering the main variables of the current study, and that attained PA recommendations (i.e., active according to the WHO PA guidelines) were included.

2.3. Ethics approval and consent to participate

Participation was entirely voluntary, and anonymity and confidentiality were assured by ethical rules for research on humans. All participants gave their informed consent before completing the questionnaire digitally. The LusófonAtiva project obtained ethical approval favorable granted by the institutional ethics committee of Universidade Lusófona de Humanidades e Tecnologias, on January 20, 2021. The protocol complies with legislation, international conventions, and ethical research practices.

2.4. Variables

Demographic data: Information on age, sex at birth, financial status, and occupation (employees, teachers, and students) was self-reported. Financial status was assessed through the personal perception of the current financial situation, with the question: "How do you classify your current financial situation?" ("Difficult" and "Very difficult" [classified as "low financial perception"; "sufficient to pay the bills" [classified as "medium financial perception"], "comfortable" and "very comfortable" [classified as "high financial perception"]) and was used as a categorical variable. Age was used as a continuous variable.

Well-being: Following recent guidelines for the selection of well-being measures (VanderWeele et al., 2020), a set of items representative of each aspect of subjective well-being was created. They presented themselves on scales from 0 "not satisfied" to 10 "completely satisfied" about work/course, personal relationships, and free time to do what they like (assessing the hedonic and evaluative facets of well-being). It was calculated as a mean of these 3 items and used here as "general satisfaction with life" [GSL]). In addition, to assess the eudaimonic facet of well-being, the following question was used: On a scale from 0 to 10, how much do you agree with these statements: "I feel that my life and the things I do are worthwhile" and "I feel my life has purpose and direction", used herein as "psychological well-being"

(PWB). Then the average of the 2 items was calculated, with higher values indicating more well-being in both cases.

Health-related quality of life (HRQoL): It was evaluated through the 12-item Short Form Survey (SF-12) (Gandek et al., 1998) that is a self-reported method that assesses the health impact on an individual's everyday life, and it is an abbreviated version of his predecessor, the SF-36 (Ware & Sherbourne, 1992) with 36 items. The SF-12 contains a subset of 12 items of the SF-36, with one or two items from each of the eight original questionnaire scales, considered too long for large group comparisons and longitudinal monitoring. The information of all 12 items is used to construct a summary measurement of total (range from 12 to 60 points), physical (PCS – range from 6 to 30 points) and mental component (MCS – range from 6 to 30 points) without losing their reliability. The response options were "never" (5 points), "shortly" (4 points), "some time" (3 points), "most of the time" (2 points), and "always" (1 point). The questions were coded so that the highest score indicated better HRQoL and were used as continuous variables.

Physical activity: It was assessed with the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). The IPAQ was chosen because it is an internationally validated questionnaire that has already been tested in several countries and demonstrated acceptable properties of reliability and validity, especially in urban samples (Craig et al., 2003). The cutoff point for being considered physically active or inactive was established in accordance with current WHO recommendations (Bull et al., 2020; Thivel et al., 2018), i.e., "meeting the recommended PA goal" (≥150 min/week of moderate PA or ≥75 vigorous) or "not meeting the recommended PA" (<150 min/week of PA moderate or <75 vigorous). Since we only included the data from participants that were considered physically active, we used the question "What kind of physical activities do you usually do?" with several response options, ranging from sports (team or individual sports) and physical exercises (running, dancing, strength training, group classes) – classified as 'leisure PA' and an option "I do not practice structured PA", to classify the physical activities as 'incidental PA'. In addition, participants were asked about the average daily number of steps (if they used this facility on their smartphone).

Sedentary behavior: It was also assessed with IPAQ, by asking the duration (the average time in hours per day) that the person spends sitting during a weekday and a weekend day. In addition, to capture the domains of SB, questions were created regarding the time that participants usually sit at work/school (occupational), on transport, and in their leisure-time.

The questions were as follows: “On average, how much time do you usually spend sitting at study/work per day?”, “On average, how much time do you usually spend sitting making a hobby, watching TV, using the computer/tablet/cell phone for leisure per day”, and “On average, how much time do you spend sitting on public/private transport per day?”. The answers were weighed by day [min/day]) through the weighted arithmetic average of the responses of the time spent in sedentary behavior on weekdays and weekend days, and the time spent in each domain was used as continuous.

Body mass index (BMI): BMI was calculated as weight/height^2 [kg/m^2], according to the self-reported body weight and height, and used as a continuous variable.

Smoking history: It was assessed through the question “Have you ever smoked?”, with three response options: "Never smoked"; "I have smoked, but I do not currently smoke"; and "currently smoking”) and used as a categorical variable.

Sleep duration: The amount of sleep was assessed by the questions: "In a typical week, what time do you usually lie down at night?” and “In a typical week, what time do you usually get up in the morning?". The results (in hours and minutes) were used to calculate the difference between moments and the sleep length was used as a continuous variable.

Sleep quality: It was assessed by averaging the answers to the following questions: "In a typical week, do you have trouble sleeping?; "In a typical week, do you have trouble staying awake during meals, classes/work while driving or participating in a social activity?". The answer options were as follows: "never" (4 points); "fewer than once a week" (3 points); "1 or 2 times a week" (2 points); "3 or more times a week" (1 point), with more points indicating a better quality of sleep, ranging from 2 to 8 points. Sleep quality was used as a continuous variable.

Presence of chronic disease: It was assessed through the question “Do you have any chronic illness (physical or psychological), or disability diagnosed by a doctor?”, with two response options: “Yes or not”, being used as a dichotomic variable.

Adherence to the Mediterranean diet: It was assessed using an 11-item original questionnaire assessing adherence to the Mediterranean diet (Panagiotakos et al., 2007), in which participants report the weekly consumption of 9 food groups (i.e., 1) non-refined cereals, 2) fruits, 3) vegetables, 4) legumes, 5) potatoes, 6) fish, 7) meat and meat products, 8) poultry, and 9) full-fat dairy products including cheese, as well as olive oil used in cooking, and alcoholic beverage intake, based on the principles of the traditional Mediterranean Diet. Each response given for an item had a scale of 0 to 5 (never, rare, frequent, very frequent, weekly, and daily consumption), or on a reverse scale (i.e., from 5 to 0) for food groups presumed away from the Mediterranean Diet. Thus, a composite score was calculated and used as a continuous variable, with higher scores representing higher adherence to this pattern, ranging from 0 to 55.

2.5. Statistical analysis

Data analyses were performed using the software The Jamovi project (2021), version 2.2, and the significance level was maintained at 5%. Data normality was verified by the Shapiro–Wilk test. Sample characteristics are presented as the mean and standard deviation for the continuous variables and as frequencies for the categorical variables. We separated our sample groups into 'leisure PA' and 'incidental PA', and to test the differences between groups, we used the Mann–Whitney test for all variables that did not present a normal distribution. To test group (and sex) differences for the adherence to the Mediterranean diet, an independent samples T-test was used, since this variable was normally distributed. For the categorical variables, we used the chi-square test.

3. Results

3.1. Overall results

The total sample (n=378) consisted of 24 employees (6.3%), 75 teachers (19.8%), and 279 students (73.8%). Sample characteristics are described in Table 1 and Table 2, and the differences in mental and physical health indicators between being active in leisure-time vs incidentally (i.e., in transport/work) are described in Table 3 for the whole sample and by sex at birth.

Table 1. Characterization of the sample – continuous variables.

Variables	Mean	Standard deviation
Continuous Variables		
Age	31.2	± 13.1
Body mass index (BMI) kg/m^2	23.8	± 4.1
Sleep duration (h)	7.2	± 1.5
Sleep quality (2 to 8 pts)	3.0	± 0.8
Adherence to Mediterranean Diet (0 to 55 pts)	29.0	± 4.8
Sedentary behavior total (min/day)	357.2	± 120.5
Sedentary behavior – Domains (min/day)		
Leisure-time	215.5	± 143.0
Transport	70.2	± 56.3
Occupational	410.8	± 182.7
Physical activity (min/week)		
Vigorous intensity	219.8	± 232.0

Moderate intensity	359.0	± 307.0
MET/week	4291.9	± 2757.9
Walking (min/week)	368.8	± 332.4
Well-being measures		
GSL (mean of 3 items – 0 to 10 points)	6.3	± 2.0
PWB (mean of 2 items – 0 to 10 points)	7.6	± 2.2
Quality of life		
SF-12 (total)	44.9	± 6.9
SF-12 (physical component)	22.2	± 3.1
SF-12 (mental component)	22.5	± 4.9

Abbreviations: GSL, general satisfaction with life; PWB, psychological well-being; SF-12, short-form 12 items. Note: Data normality was verified by the Shapiro–Wilk test (i.e., p >0.05 means normality exists).

Table 2. Characterization of the sample – categorical variables

Categorical variables	N	% of the sample
Sex		
Male	155	41.0
Female	219	57.9
Rather not answer	4	1.1
Chronic disease		
Yes	41	19.8
Not	166	80.2
Financial situation perceived		
Low	44	11.6
Medium	191	50.5
High	143	37.8
Smoking history		
Never smoked	132	62.9
Have smoked, but currently do not	46	21.9
Currently smoking	32	15.2
Being Active through		
Incidental physical activity	108	25.8
Leisure-time physical activity	270	64.7

Our analyses indicated no differences between those who were active in IPA, in comparison to the ones being active in leisure-time for 14 out of 19 analyzed factors. However, those who were active in leisure-time spent significantly less time in leisure-time sedentary behavior (-42.8 min/day; p=0.019), presented more vigorous PA (+150 min/week; p<0.001), had greater energy expenditure per week (+741 MET/week; p<0.001), presented a higher adherence to the Mediterranean diet (+1.7 points; p=0.017), and scored better in the physical component of quality of life (+1.0; p=0.010), than those who were active through IPA. On the other hand, those active in IPA performed more PA of moderate intensity (+60 min/week; p=0.007). Besides that, when looking at the data by sex, in males we can observe that the ones who were active in leisure-time had significantly more vigorous PA (+180.0 min/week; p<0.001), higher weekly energy expenditure (1067 METS/week; p=0.015), and less sedentary leisure-time (-94 min/day; p=0.007), when compared with those active through IPA. Alternatively, the data from women indicated that those who were active in leisure-time had higher scores in the physical component of the SF-12 (+1.0; p=0.019), greater adherence to the Mediterranean diet (+2.89; p=0.003), and more time in vigorous PA (+120 min/week; p<0.001) than those active through IPA. In contrast, the ones active in incidental PA had more time in moderate PA (+90 min/day; p=0.002).

Table 3. Differences in physical and mental indicators between being active in leisure-time *vs.* being active through incidental physical activity.

	Total		Male		Female	
Comparison	Mann–Whitney test/T test Chi-square	Mean difference	Mann–Whitney test/T test Chi-square	Mean difference	Mann–Whitney test/T test Chi-square	Mean difference
	P value					
Body mass index (kg/m²)	0.411	-0.36	0.101	-1.06	0.479	-0.38
Sleep duration (h/day)	0.213	1.50	0.172	1.22	0.294	4.31
Sleep quality	0.304	7.84	0.152	7.57	1.000	7.16
Sedentary behavior (min/day)	0.073	-25.7	0.147	-38.5	0.302	-17.1
Leisure-time sedentary behavior (min/day)	**0.019**	**-42.8**	**0.007**	**-94.0**	0.216	-28.0
Transport sedentary (min/day)	0.363	-5.71	0.556	-5.71	0.232	-8.57
Occupational sedentary behavior (min/day)	0.417	-21.4	0.177	-64.2	0.985	-1.01
Vigorous intensity PA (min/week)	**<0.001**	**150.0**	**<0.001**	**180.0**	**<0.001**	**120.0**
Moderate intensity PA (min/week)	**0.007**	**-60.0** #	0.616	-30.0	**0.002**	**-90.0** #
MET/week	**0.001**	**741**	**0.015**	**1067**	0.095	429
Walking (min/week)	0.506	-33.0	0.637	-66.0	0.420	-66.0
Adherence to Mediterranean Diet	**0.017**	**1.79**	0.842	0.24	**0.003**	**2.89**
General satisfaction with life	0.156	0.333	0.656	0.333	0.189	0.667
Psychological well-being	0.268	1.44	0.815	7.56	0.292	0.50
SF-12 (total)	0.105	2.0	0.467	1.0	0.171	2.0
SF-12 (physical component)	**0.010**	**1.0**	0.290	1.0	**0.019**	**1.0**
SF-12 (mental component)	0.575	3.7	0.838	2.4	0.808	2.3
Smoking history	0.436		0.533		0.707	
Chronic disease	0.105		0.454		0.190	

Abbreviations: PA: Physical activity; SF-12: short form survey-12. **Bold**: p<0.05; # in favor of incidental physical activity.

4. Discussion

The aim of this investigation was to assess differences in health indicators between adults who attain WHO PA recommendations through LTPA versus IPA and additionally explore differences by sex. This is important because there are various disparities in the distribution and access to PA between countries/cultures, and the majority of the recommendations of PA are based on questionnaires that do not appropriately report IPA and underestimate total PA, besides that, PA recommendations give the idea that achieving the amount of PA independently of the domain will bring the same health benefits.

Our analyses indicated that those who were active in leisure-time spent significantly less time in leisure-time sedentary behavior, presented more vigorous PA, had greater energy expenditure per week, presented a higher adherence to the Mediterranean diet, and scored better in the physical component of HRQoL, than those who were active through IPA. On the other hand, those active in IPA performed more PA of moderate intensity.

Spending less time in leisure-time sedentary behavior was expected for leisure-time active participants, since the time for PA would be displaced from other behavior in the same domain, and in this case, the benefits can be added, since, among all types, SB in the leisure context has been indicated as the most harmful to the mental and physical health of adults and young people (Hallgren et al., 2020; Patel et al., 2018; Su et al., 2023).

The highest energy expenditure of those active in LTPA is not surprise, given that, IPA such as sitting tasks with moderate effort (e.g., operating heavy machinery or instruments), standing with minor effort (e.g., active workstation), or walking for transport (e.g., walking to work/school) and household are considered low to moderate intensities PA (Brooks et al., 2004; Holtermann & Stamatakis, 2019), what can explain the larger energy expenditure found in participating in LTPA. As a result, the LTPA could play an important role in controlling and maintaining weight, which could impact chronic disease in the long term.

Another point that deserves to be highlighted is the higher score that LTPA participants had in the physical component of HRQoL. This component of the quality of life questionnaire evaluates how the person perceives his/her health, if he/she feels limitations for moderate-intensity activities and for climbing stairs, if the respondent feels any limitation at work due to problems related to his/her physical health or pain. Thus, since LTPA potentially has a higher physiological load, reporting a higher score in this component therefore suggests the capability of greater physical fitness to improve a person's HRQoL. On the other hand, IPA may be of low intensity most of the time or high only for brief moments, likely not enough to improve cardiorespiratory fitness or strength. IPA could also keep the heart rate and blood pressure high for several hours during the shift/work period, maintain the isometric contraction of postural muscles when handling objects or loads, and still not have the proper recovery time in workers (Holtermann et al., 2012, 2018), which could lead to hypertension (Korshøj et al., 2021) and cardiac disease (Holtermann et al., 2010), mainly in people with low physical fitness. In fact, a systematic review indicated strong evidence that for adults aged 18 to 65 years and older adults, PA improved quality of life when compared with minimal or no treatment controls; however, all types and intensities of physical activities, as well as free living activities and exercises, were included in the search strategies, making it difficult to discern between the relationships between LTPA or IPA and HRQoL (Marquez et al., 2020).

Participants who achieved the weekly recommendations through LTPA were also those with greater adherence to the Mediterranean diet, which has been considered one of the healthiest dietary models in the world (Morris & Bhatnagar, 2016), capable of contributing to reduce both metabolic and cardiovascular diseases and the management of depressive symptoms (Ventriglio et al., 2020). The Mediterranean diet is mainly based on the regular consumption of extra virgin olive oil (as the main source of added fat) and plant-based food (whole grains, vegetables, legumes, fresh fruits, nuts, seeds, herbs and spices), a moderate amount of fish, seafood, dairy and poultry and a low consumption of red and processed meat, sugars, alcohol (mostly red wine) and pastry (Davis et al., 2015). In fact, in a recent review, the combination of a Mediterranean dietary pattern plus PA demonstrated improvements in cardiovascular health, metabolic disorders, bone and muscle and neurological health, in addition to reducing the chances of all-cause mortality (Caprara, 2021); however, not all of the included studies were derived from LTPA, although most of them used compliance with PA guidelines as a cutoff criterion. Future studies will need to differentiate between incidental and LTPA to know whether the extent of this combination remains when PA domains are considered.

4.1. Differences by sex

When looking at the data by sex at birth, among males we can observe that the ones who were active in leisure-time had significantly more vigorous PA, higher weekly energy expenditure, and less sedentary leisure-time, when compared with those actives through IPA, indicating, as previously said, a shift from sedentary leisure time to PA and more benefits to being active in LTPA. On the other hand, the data from women indicated that those who were active in LTPA had higher scores in the physical component of the SF-12, greater adherence to the Mediterranean diet, and more time in vigorous PA, than those active through IPA. The only difference found in women active in IPA, was more time in moderate intensity PA (+90 min/week), unlike men who, between them, just had more 30 min/week (no statistical significance - Table 3).

Since people considered active in IPA reported not performing structured PA, this difference can probably be explained by the recognized larger women's participation in activities related to home and family care. Data by Organization for Economic Co-operation and Development's (OECD) Stata database indicates that Portuguese women spend an average of 126.9 min/day more than men in unpaid work (*Employment : Time spent in paid and unpaid work, by sex*, 2023) (i.e., work that refers to services provided within a household to its members, including personal care and household chores (Elson, D., 2000). However, it is important to note that these types of work are associated with several problems such as cardiovascular diseases (Hall et al., 2019) or stress, especially in women (Milkie et al., 2021). Besides that, general homework activities present a low to moderate intensity (Shephard, 2012), which could prevent from developing physical fitness.

Thus, our data highlight the importance of considering the domain of PA to public health, identifying LTPA as the domain that can be more prone to improve health of the adult population. This can (partially) corroborate with what has been called the paradox of PA (i.e., not all PA is equally good for health) (Gupta et al., 2020; Holtermann et al., 2012), since, we did not observe any advantage in the health indicators analyzed for people considered active in IPA. Besides that, our data and others alike can contribute to the creation of more precise PA recommendations, that can attend to the needs of the entire population (i.e., different sections of the population), avoiding the message that people who can only meet the minimum recommended amount in non-leisure domains will obtain the same benefits as those who performed PA in leisure-time, lowering perpetuated health inequalities.

5. Strengths and limitations

There are several limitations to this study. Questionnaire-based measures are prone to measurement error, and participants in our study may have overreported their levels of PA, as well as underreported periods of sedentary behavior, which has been attributed to social desirability and non-recall of some types of PA (Adams et al., 2005). In addition, the cross-sectional nature of the data does not allow causality to be inferred. Another important limitation is that even though the questionnaire used indicated several examples of physical exercises and a line for the insertion of any other type of exercise that was not on the suggested list, we believe that participants who practice PA for leisure/distraction, but without the aim of improving physical fitness, may not have found a way to describe their activity (e.g., skateboarding, surfing). In future analyses, more comprehensive questionnaires should be used to better assess the domains within which PA is accumulated and when they happen together. Finally, we analyzed the differences between sexes at birth and not by gender (i.e., socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time), which cannot be applicable when the gender do not is the same sex at birth. The strengths of this study may be the use of several questionnaires validated in the literature, and the novelty in the exploration of the domains of PA, which is in line with recent recommendations (Quinn & Gibbs, 2023).

6. Conclusion

Although the main health entities recommend the practice of PA in any domain, our data suggest that the PA performed in the leisure-time seems to promote a healthier profile, potentially with a more important role in reducing the risk of chronic diseases than IPA. Also, men and women can differentially benefit from being active in the leisure time.

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Chapter VI

Study 4: Domains of sedentary behavior

Tempo rei, ó Tempo rei:

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Gilberto Gil

Chapter VI

Associations between domains of sedentary behavior, well-being, and quality of life – A cross-sectional study. *[4]

Abstract

The importance of reducing sedentary behavior (SB) in the prevention of mortality and chronic and mental diseases is scientifically well grounded, but SB can be accumulated in diverse domains of life, such as leisure-time SB, transport between home/work/school when sitting (transport-related SB), or in occupational settings such as working or studying (occupational SB), and the associations for each domain of SB with well-being measures and quality of life are still underexplored from a positive perspective. Through a cross-sectional investigation, we collected data from 584 participants who completed a questionnaire throughout November 2021 and with Spearman correlation test, analysed the associations between SB in three different domains with psychological well-being, satisfaction with life, and quality of life. Our results indicated that after adjustment for physical activity, sex, body mass index, smoking history, chronic disease status, financial perception, quality/duration of sleep and university group, in younger adults (18 to 24 years old), leisure-time SB was negatively related to psychological well-being (rho = -0.255; p=0.008), and in adults (25 to 64 years old), occupational SB was negatively related to satisfaction with life (rho = -0.257; p<.001) and the mental component of quality of life (rho = -0.163; p=0.027). Our findings highlight the idea that not all SB is built the same and that future strategies to reduce SB from people's lives must target specific domains of SB according to the age group when aiming to improve well-being and quality of life.

Key words: sedentary behavior; domain specific; well-being; psychological well-being; quality of life

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1. Introduction

The importance of reducing sedentary behavior (SB) in the prevention of chronic diseases and mortality (Patterson et al., 2018) is scientifically well grounded, and recently, interest in the relation between SB and mental disorders has been growing (Y. Huang et al., 2020; Rodriguez-Ayllon et al., 2019; Vancampfort et al., 2020), since both have increased in the past decade (‘Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019’, 2022; López-Valenciano et al., 2020). SB is characterized by a series of activities in a sitting or reclining posture with low energy expenditure (≤ 1.5 metabolic equivalents [MET]) while awake (Tremblay et al., 2017), such as the use of electronic devices (e.g., television, computer, tablet, phone); reading/writing/talking while sitting; and sitting in a bus, car or train. In cross-sectional investigations, excessive SB accumulation has been associated with mental health problems (i.e., anxiety, depression, and suicidal thoughts in colleges (Jiang et al., 2020), anxiety and depression in adults (Hallgren et al., 2020), and symptoms of depression in older adults (Luo et al., 2022)). A direct association between SB and the risk of depression has also been observed (Y. Huang et al., 2020). However, sedentary pursuits can be accumulated in diverse domains of life, such as leisure-time SB, including watching TV or using social media (Kikuchi et al., 2014), transport between home/work/school when sitting (transport-related SB), or in occupational settings such as working or studying (occupational SB), but investigations about their prevalence and its relation with mental health in adults are scarce (Bakker et al., 2020; Loyen et al., 2019; Mielke et al., 2014).

Recently, investigations have been looking into this topic from a positive perspective, that is, not analysing the associations with mental disorders but also evaluating the relationship with mental well-being (Zhang & Chen, 2019). There is no consensus around a single definition of well-being, but there is a general agreement that includes the presence of positive emotions and moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life and positive functioning (Diener, 1984; *Well-Being Concepts | HRQOL | CDC*, 2018). This definition includes a hedonic and evaluative aspect (affects and life satisfaction, used here as subjective well-being) and a eudaimonic feature (self-acceptance, autonomy, control under the environment, positive relationships, purpose in life and personal development) – used as psychological well-being (Ryff, 1989; Ryff & Keyes, 1995). Quality of life is another form to assess people’s well-being; therefore, the World Health Organization (WHO) defines quality of life as an individual’s perception of their position in life in the context of the culture and value systems in which they live and about their goals, expectations, standards, and concerns (The World Health Organization, 1995). On the individual level, quality of life has been assessed through health-related quality of life (HRQoL) and includes physical and mental perceptions (National Center for Chronic Disease Prevention and Health Promotion (U.S.). Division of Adult and Community Health., 2000).

The prevalence of SB accumulation among different domains has rarely been explored from this perspective, and it can be of relevance. For example, younger adults (i.e., 18 to 24 years) and older adults (i.e., ≥ 65 years) seem to be slightly more sedentary in their leisure time (Bakker et al., 2020; Loyen et al., 2019), while adults spend more time in occupational SB. An investigation with university students (mean age 20 [± 1.5]) found that they spent over 12/day in SB, with a third of this time being spent in leisure time (Carpenter et al., 2021). Another investigation (Nowak et al., 2019) conducted in university students (mean age 21 [± 1.8]) found that weekday SB was positively related to one dimension of quality of life (intimacy), while SB on weekends was negatively related to some dimension of quality of life (intimacy, safety and communicative with others). On the other hand, a study focusing on university employees (Puig-Ribera et al., 2015) (mean age 42 [± 9] indicated that longer sitting time on weekdays was associated with decreased mental well-being, suggesting that, in addition to the context, age group can have some influence on the relationship between SB and well-being or quality of life.

Thus, although the current recommendations about SB are “"sit les”" or “minimize time sitting in front of screens” from the WHO (Bull et al., 2020), we believe that in regards to well-being and quality of life, it is prudent to further understand how each domain of SB can relate to people’s well-being so that the recommendations can be more accurate (Teychenne et al., 2020). Therefore, this study aims to evaluate the cross-sectional associations for three SB-specific domains (i.e., leisure, occupational, and transport-related) with measures of well-being and quality of life and whether it differs between a sample of younger adults and adults from a Portuguese university.

2. Method

2.1. Design

This is a cross-sectional investigation with data from the LusófonAtiva Project that aimed to design and implement a digital system for monitoring physical behaviors linked to healthy lifestyles (ILIND/F+/EI/02/2020). This study was developed and implemented at the largest private university in Portugal. Participants were recruited online via convenience sampling through invitations via email and university social networks with a link to the questionnaire (via the Qualtrics platform) throughout November 2021.

2.2. Study population

This is a subsample from the 791 participants from the university campus who volunteered to participate, as for these analyses, we only included data from 584 participants who completed the questionnaire considering the main variables of the current study (SB).

2.3. Measures

Sedentary behavior: Total SB was assessed with the short version of the International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003). The IPAQ was chosen because it is an internationally validated questionnaire that has already been tested in several countries and demonstrated acceptable properties of reliability and validity, especially in urban samples (Craig et al., 2003). However, to capture the domains of SB, questions were created regarding the time that participants usually sat at work/school (occupational SB), on transport (transport-related SB), and in their leisure time. The questions were as follows: “On average, how much time do you usually spend sitting at study/work per day?”, “On average, how much time do you usually spend sitting making a hobby, watching TV, using the computer/tablet/cell phone for leisure per day”, and “On average, how much time do you spend sitting on public/private transport per day?”. The answers were weighted by day [min/day]) through the weighted arithmetic media of the responses of the time on weekdays and weekend days in each domain of SB and were used as continuous variables.

Well-being: Following recent guidelines for the selection of well-being measures (VanderWeele et al., 2020), a set of items representative of each aspect of subjective well-being was created. They presented themselves on scales from 0 "not satisfied" to 10 "completely satisfied" about work/course, personal relationships, and free time to do what they like (assessing the facets of hedonics and evaluative of well-being). It was calculated as a mean of these 3 items and used here as “general life satisfaction” [GLS]). In addition, to assess the eudaimonic facet of well-being, the following question was used: On a scale from 0 to 10, how much do you agree with these statements: “I feel that my life and the things I do are worthwhile” and “I feel my life has purpose and direction”, used here as “psychological well-being” (PWB), and then the mean of 2 items was calculated, with higher values indicating more well-being in both cases.

Quality of life: It was evaluated through the 12-item Short Form Survey (SF-12) (Gandek et al., 1998). It is a self-reported method that assesses the health impact on an individual's everyday life, and it is an abbreviated version of its predecessor, the SF-36 (Ware & Sherbourne, 1992), with 36 items. The SF-12 contains a subset of 12 items of the SF-36, with one or two items from each of the eight original questionnaire scales, which is considered too long for large group comparisons and longitudinal monitoring. The information of all 12 items is used to construct a summary measurement of physical and mental components without losing their reliability. For this analysis, only the measure of mental component was used: 1 item of energy/fatigue (During the last month, have you had a lot of energy?); 1 item of social functioning (To what extent, in the last month, has your physical health or emotional issues limited your social activity, such as being - even digitally - with close friends or family?); 2 items of role-emotional (As a consequence of your emotional state, a) did you do less work/study than you would like? b) Performed work or other activities less carefully than usual?); and 2 items of mental health (During the last month, did you feel blue/calm and quit?). These questions are identified in the mental component of the Short Form Survey (MCS-12), which is a valid measure of mental health in epidemiological research and a useful screening tool for both depression and anxiety disorders (Gill et al., 2007). The response options were “never” (5 points), “shortly” (4 points), “some time” (3 points), “the most part of the time” (2 points), and “always” (1 point). The questions were coded so that the highest score indicated better mental health and were used as continuous variables (ranging from 6 to 30 points).

2.4. Covariates

Based on previous evidence about the associations of body composition (Blasco et al., 2020), sex (Salk et al., 2017), age (Becker & Trautmann, 2022), chronic diseases (Moussavi et al., 2007), tobacco smoking (Milic et al., 2020), financial situation (Freeman et al., 2016), physical activity (Pearce et al., 2022), and sleep disorders (Fang et al., 2019) with depression (i.e., worse well-being), the following covariates were included in the statistical models.

Body mass index (BMI): BMI was calculated as weight/height^2 [kg/m^2], according to the self-reported body weight and height, and used as a continuous variable.

Age and sex: Self-reported and included as continuous and categorical variables, respectively (i.e., sex: male, female, or other).

Smoking history: It was assessed through the question “Have you ever smoked?”, with three response options: "Never smoked"; "I have smoked, but I do not currently smoke"; and "currently smoking”), which was used as a categorical variable.

Sleep duration: The amount of sleep was assessed by the question: "In a typical week, what time do you usually lie down at night and get up in the morning?". The results (in hours) were used as a continuous variable.

Sleep quality: Sleep quality was assessed by the mean of the answers to the following questions: 1. "In a typical week, do you have trouble sleeping? 2. "In a typical week, do you have trouble staying awake during meals, classes/work while driving or participating in a social activity?". The answer options were as follows: "never" (4 points); "less than once a week" (3 points); "1 or 2 times a week" (2 points); and "3 or more times a week" (1 point), with more points indicating a better quality of sleep, ranging from 2 to 8 points. The variable was used as a continuous variable.

Presence or absence of chronic disease: This was assessed through the question “Do you have any chronic illness (physical or psychological) or disability diagnosed by a doctor?” with two response options: “Yes or not”, which was used as a dichotomic variable.

Financial situation: This evaluation was made through the personal perception of the current financial situation. It was assessed through the question: “How do you classify your current financial situation?” ("Difficult" and "Very difficult" [classified as “low financial perception”; "sufficient to pay the bills" [classified as “medium financial perception”], "comfortable" and "very comfortable"[classified as “high financial perception”]), which was used as a categorical variable.

Physical activity (PA): PA was assessed with the short version of the IPAQ, and the participants were categorized as “meeting the recommended PA goal” (≥150 min/week of moderate PA or ≥75 vigorous) or “not meeting the recommended PA” (<150 min/week of PA moderate or <75 vigorous) according to the guidelines for PA from the WHO (Bull et al., 2020) and used as a categorical variable.

2.5. Statistical analysis

The data analyses were performed using the software Jamovi project (2021), version 2.2, and the significance level was maintained at 5%. Data normality was verified by the Shapiro–Wilk test. Sample characteristics are presented as the mean and standard deviation for the continuous variables and as frequencies for the categorical variables. Analyses were performed just with complete data, i.e., without imputed values.

We separated our sample into groups of young adults (18 to 24 years) and adults (≥ 25 to 64 years), and to test the differences between groups, we used the Mann–Whitney test, except for GSL, which we used the independent T test, since it presented a normal distribution. The chi-square test was used to verify the difference in the distribution of the responses between groups regarding the categorical variables. The associations between each specific domain of SB and GLS, PWB, and MCS were examined using the Spearman correlation test.

2.6. Ethics approval and consent to participate

Participation was entirely voluntary, and anonymity and confidentiality were assured by ethical rules for research on humans. All participants gave their informed consent before completing the questionnaire digitally, and the LusófonAtiva project obtained ethical approval granted by the institutional ethics committee of the Faculdade de Educação Física e Desporto (FEFD) belongs to Universidade Lusófona de Humanidades e Tecnologias (ULHT) on January 20, 2021. The protocol complies with legislation, international conventions, and ethical research practices.

3. Results

3.1. Overall results

The total sample (n=584) consisted of 68 employees (11.6%), 111 teachers (19.0%), and 405 students (69.3%), and the characterization of the sample is described in Tables 1 and 2.

Table 1. Characterization of the sample's continuous variables.

Variables	**N**	**% of total sample**	**Mean**	**Standard deviation**	**P value T test or Mann-Whitney**
Age					
Young adults (18 to 24 years)	262	44.8	20.4	± 1.9	
Adults (25 to 64 years)	322	55.1	41.2	± 10.2	**<.001**
Body mass index (BMI) kg/m^2					
Young adults	262	44.8	23.1	± 4.3	
Adults	322	55.1	24.8	± 4.7	**<.001**
Sleep duration (h)					
Young Adults	167	22.2	7.5	± 1.5	
Adults	236	31.0	7.3	± 1.3	**0.011**
Sleep quality (2 to 8 points)					
Young adults	167	22.2	2.7	± 0.8	
Adults	235	40.2	3.0	± 0.7	**<.001**
Sedentary behavior total (min/day)					
Young adults	262	44.8	393.8	± 135.2	
Adults	322	55.1	357.9	± 135.9	**0.001**
Sedentary behavior – Domains (min/day)					
Leisure-time SB					
Young adults	165	28.2	269.6	± 161.6	
Adults	238	40.7	170.9	± 112.0	**<.001**
Transport-related SB					
Young adults	169	28.9	86.3	± 58.9	
Adults	237	40.5	65.5	± 53.9	**<.001**
Occupational SB					
Young adults	168	28.7	466.0	± 200.3	
Adults	236	40.4	409.1	± 189.0	**<.001**
Well-being measures					

GLS (mean of 3 items – 0 to 10 points)					
Young adults	101	13.5	5.0	± 2.1	
Adults	206	27.0	6.3	± 1.9	**<.001***
PWB (mean of 2 items – 0 to 10 points)					
Young adults	134	22.9	6.6	± 2.5	
Adults	210	35.9	7.9	± 1.9	**<.001**
MCS (6 to 30 points)					
Young adults	132	22.9	19.5	± 5.2	
Adults	209	35.7	23.2	± 4.2	**<.001**

Abbreviations: SB, sedentary behavior; GLS, general life satisfaction; PWB, psychological well-being; MCS, mental component of short form survey-12.
Bold: p<0.05(*) T test.

Table 2. Characterization of the sample's categorical variables

	Young adults (N)	% of the total sample	Adults (N)	% of the total sample	P value Chi-square
Sex					
Female	182	31.1	191	32.7	
Male	75	12.8	130	22.2	
Other	5	0.6	1	0.1	**0.003**
Smoking history					
Never smoked	91	15.5	121	20.7	
I have smoked, but currently I do not	25	4.2	56	9.5	
Currently smoking	19	3.2	35	5.9	0.138
Financial situation perceived					
Low	39	6.6	41	7.0	
Medium	135	23.1	174	29.7	
High	88	15.0	107	18.3	0.717
Do you have some chronic disease?					
Yes	25	4.2	41	7.0	
Not	107	18.3	168	28.7	0.877
Met the physical activity recommendations					
Yes	162	27.7	194	33.2	
No	86	14.7	104	17.8	0.957

Bold: p<0.05

As expected, Tables 1 and 2 show that there were several differences between age groups both in the independent and dependent variables, justifying a deeper investigation (see item 3.2). Table 3 shows the raw associations between SB domains and well-being measures (GSL, PWB and MCS-12) and the adjusted models.

Table 3. Correlations for sedentary behavior domains with well-being measures and quality of life for the entire sample

	Unadjusted model			
		Leisure-time SB	Occupational SB	Transport-related SB
GLS	Spearman's rho	-0.091	**-0.292*** **	**-0.136***
	p value	0.117	**<.001**	**0.018**
	N	300	300	302
PWB	Spearman's rho	**-0.172****	**-0.166****	**-0.152****
	p value	**0.002**	**0.002**	**0.005**

	N	336	336	337
MCS-12	Spearman's rho	**-0.215*** **	**-0.191*** **	-0.072
	p value	**<.001**	**<.001**	0.189
	N	333	333	334
	Adjusted model			
GLS	Spearman's rho	0.046	**0.232*** **	-0.052
	p value	0.453	**<.001**	0.397
	N	278	278	281
PWB	Spearman's rho	-0.040	-0.087	-0.098
	p value	0.490	0.132	0.091
	N	310	310	312
MCS-12	Spearman's rho	-0.040	-0.059	0.039
	p value	0.486	0.312	0.495
	N	310	310	312

*p<.05; **p<.01; ***p=<.001
Adjusted model for age, sex, compliance with PA guidelines, BMI, smoking history, chronic disease status, financial perception, sleep (quality and duration) and university group (student, teacher, or staff).
Abbreviations: GLS, general life satisfaction; PWB, psychological well-being; MCS-12, mental component of short form survey-12; SB, sedentary behavior.

The analyses for the overall sample indicated that two of the three domains of SB were negatively and significantly associated with GLS (transport-related SB [p=0.018] and occupational SB [p= <.001]). Furthermore, the three domains of SB were negatively associated with PWB (leisure-time SB and occupational [both, p=0.002], and transport-related SB [p=0.005]), and two were negatively associated with MCS-12 (occupational SB and leisure-time SB – both p<.001). In the adjusted model, the associations were attenuated, and only occupational SB remained negatively associated with GLS (p<.001), as described in table 3.

3.2. Subgroup analysis

As differences were found between younger adults and adults for both the independent and dependent variables (see Tables 1 and 2), we examined the correlations between SB domains and measures of well-being and quality of life while separating the two age groups (Table 4).

Table 4. Correlations for sedentary behavior domains with measures of well-being and quality of life separated by age group.

		Leisure-time SB	Occupational SB	Transport-related SB
Young adults	**(18 to 24 years old)**			
GLS	Spearman's rho	0.023	-0.198	0.026
	p value	0.843	0.078	0.819
	N	88	89	91

PWB	Spearman's rho	**-0.255****	-0.052	-0.011
	p value	**0.008**	0.595	0.907
	N	116	117	118
MCS-12	Spearman's rho	-0.150	0.053	0.185
	p value	0.124	0.583	0.054
	N	116	117	118
Adults	**(25 to 64 years old)**			
GLS	Spearman's rho	0.045	**-0.257*****	-0.097
	p value	0.551	**<.001**	0.195
	N	190	189	190
PWB	Spearman's rho	0.013	-0.107	**-0.176***
	p value	0.857	0.149	**0.017**
	N	194	193	194
MCS-12	Spearman's rho	-0.027	**-0.163***	-0.067
	p value	0.713	**0.027**	0.363
	N	194	193	194

*p<.05; **p<.01; ***p=<.001
Adjusted model for compliance with PA guidelines, sex, BMI, smoking history, chronic disease status, financial perception, quality, duration of sleep and university group (student, teacher, or staff).
Abbreviations: GLS, general life satisfaction; PWB, psychological well-being; MCS-12, mental component of short form survey-12; LTSB, leisure time sedentary behavior; OSB, occupational time sedentary behavior; TSB, transport time sedentary behavior.

4. Discussion

To the authors' knowledge, research on the relationship between distinct SB domains and mental health outcomes through a positive perspective is very scarce (Scarabottolo et al., 2022). We found that SB was highly prevalent among the participants in the occupational pursuits. Our data indicated that all the domains of SB were negatively associated with PWB. Occupational SB and transport-related SB were negatively correlated with GLS, and leisure-time SB and occupational SB were negatively associated with MCS-12 in the unadjusted mode. In the adjusted model, the associations were attenuated, and only occupational SB remained negatively associated with GLS. Thus, taken together with the results of the present investigation, our findings differ from those of Scarabottolo et al. (2022) (Scarabottolo et al., 2022), where it was reported that screen time (i.e., watching television, using computers, and cell phones – without clarifying if for leisure or occupational purposes) may be negatively associated with social functioning (component of HRQoL) but positively related to other components (i.e., physical functioning, role-physical and role-emotional) after two years of follow-up.

Although the mechanisms linking SB with mental health are still unknown, several hypotheses may be suggested. First, SB takes time away from PA, which in turn is responsible for the prevention and treatment of diseases or conditions that impair well-being (such as depression and anxiety) (Schuch & Stubbs, 2019), possibly due to the mediation of biological factors (such as interleukin 6 and brain-derived neurotrophic factor [BDNF] release during exercise). In addition, there are clinical factors (such as global functioning and frequency of physical symptoms), psychological factors (life satisfaction and self-esteem) and social factors (such as social support and marital status) associated with PA (Schuch et al., 2016) that can also affect mental health. Second, longer sitting time has been associated with social isolation (i.e., physical, social, or psychological separation from individuals or groups) (Warren, 1993) in adolescents (Werneck et al., 2019) and in older people (Tully et al., 2019), and the evidence shows that socially isolated people are more likely to suffer from suicidal thoughts (Stickley & Koyanagi, 2016) and depression (Matthews et al., 2016).

Recognizably, there are studies showing associations between lifestyle factors and depression; thus, after the adjustment for age, sex, compliance with PA guidelines, BMI, smoking history, chronic disease status, financial perception, and sleep (quality and duration), there was an expected attenuation of the negative relation between SB domains and well-being outcomes. As a result, only the negative relation for occupation SB with GLS remained ($p<.001$), meaning that this relation was stronger and that it may be independent from the covariates included in the model.

4.1. Findings in young adults

Our second goal was to identify whether the associations between SB domains and mental health outcomes differed with age. Our analyses indicated that leisure-time SB was negatively associated with PWB ($p=0.008$) in young adults (18 to 24 years old), but we found no associations for the other SB domains.

One of the reasons why leisure-time SB may be negatively associated with PWB in young adults may be due to a reduction in PA during leisure time (competing with SB), which has been associated with higher levels of PWB with a positive impact on self-acceptance, positive relations with others and purpose in life (Rodríguez-Bravo et al., 2020). In addition, the domain of PA is important. A study that evaluated the relation between different domains of PA and positive mental health in 456 men (mean age 29 years) indicated that only PA during leisure time was associated with better mental health, and no association was found for the commuting and occupational PA domains (Appelqvist-Schmidlechner et al., 2020). Another reason for leisure-time SB being negatively related to PWB may be that younger adults (recently emerged from adolescence) spend much of their leisure-time in front of screens (Carpenter et al., 2021), as they are the largest users of social networks (such as Instagram® and TikTok®). In fact, a 2022 survey (Atske, 2022) reported that nearly all American teens (95%) have access to a smartphone (with few differences between income brackets [from 93% to < $30.000 to 96% >$75.000]), and 45% are "almost constantly" connected. Likewise, this phenomenon extends to young adults, where 96% of individuals from 18–29 years old report having a smartphone (Pew Research Center, 2021), with approximately 70% of them indicating daily use. Although not all studies corroborate the negative impact of social media on the PWB and mental health of young people (Berryman et al., 2018; C. Huang, 2017), with its use being important and facilitating social connection and support (Hjetland et al., 2021), it can certainly harm PWB, mainly depending on how, with whom, and why social media is used (Yang et al., 2021).

In addition, recent investigations have shown that younger people are the most exposed to various types of content, potentially criminals (cyberbullying, cyber-dating violence, sextortion, sexting, revenge porn, online dating, catfishing, and scammers) (Paat & Markham, 2021), with potential consequences on mental health (Maurya et al., 2022). Finally, in the younger group (18 to 24 years), the time spent in occupational SB was not associated with well-being outcomes, even acknowledging that they were the group spending more time in occupational SB (i.e., spending more 57 min/day than adults). This can possibly be justified by the younger adults of our sample, being predominantly students, spending its time in an occupational, educational environment, which can be perceived as a time dedicated to a purpose and direction in life, as a choice task that will bring meaning and benefits to society and themselves, while the adults are predominantly employees (staff and teachers).

4.2. Findings in adults

In adults (≥ 25 years), after all the adjustments, occupational SB was negatively associated with GLS ($p<.001$) and MCS ($p=0.027$), and transport-related SB was negatively associated with PWB ($p=0.017$). In contrast to what happened in the younger group, leisure-time SB was not associated with well-being outcomes. Our cross-sectional observations are in line with the results from an experimental study with 146 office workers that assessed the efficacy of SB reduction through the use of standing desks versus a control group, while using objective measures and found a significant reduction in sitting time (-83.28 min/working day after 12 months) with repercussions in a reduction in daily anxiety after 6 and 12 months and an improvement in quality of life (Edwardson et al., 2018), providing insights that sitting time in the work setting can be harmful to mental health in adults. In addition, an investigation with more than 44,978 employees indicated that prolonged sitting time without breaks at work is associated with an increased risk of self-reported overall poor health and back/neck pain, important components of physical health, which can impact the quality of life by reducing well-being (Kallings et al., 2021).

In our analysis, transport-related SB was associated with a reduction in PWB in adults, even though they spent less time commuting (≅21 min/day) than younger adults. Previous studies have explored the relationship between time spent commuting while sedentary and several measures of life satisfaction in workers (satisfaction with work, home, personal life and leisure time) and reported a negative effect of commuting on all variables above, especially for workers with lower income who live in areas of high population density (Simón et al., 2020) and thus are more exposed to traffic jams. In this case, in addition to being exposed to the negative effects of SB "*per se*", the added stress of lack of control over time and the transfer of time with family and friends or other activities could reduce PWB, according to resource drain theory (i.e., the transfer of finite personal resources, such as time, attention, and energy, from one domain to another) (Edwards & Rothbard, 2000).

It should be noted that leisure-time SB was not related to any of the measures of well-being and quality of life in our investigation, possibly because adults in our sample may be less likely to be involved in the situations mentioned in topic 4.1, which leads younger adults to have worse PWB. In addition, what may contribute to this nonrelation is the fact that our sample of adults spent significantly less time in leisure time compared to young adults (170 min/week versus 269 min/week, respectively).

5. Strength and limitations

Although our study provides new insights into the relation between domains of SB and well-being/quality of life by age group, the main limitation was the cross-sectional nature of the data, which does not allow for the inference causality. In addition, by using questionnaires, we are more prone to recall and social desirability, which can result in an underestimation of SB. Another problem is that our sample failed to respond to many questions (missing data), which caused a reduction in the initial sample. However, we must mention as a strength the fact that this investigation is one the first to assess the relationship between several SB domains and well-being measures through a positive perspective (that is, not only analysing the associations with mental disorders but also with well-being) and considering distinct age groups, which, as shown, may possibly explain some of the prior inconsistent findings on this topic. Besides that, the exploration of the domains (or contexts) are in line with recent recommendations for public health (Quinn & Gibbs, 2023).

5.1. Theorical and practical and implications

Reducing physical inactivity in the global population has been a challenge, and the associate burden of chronic and mental diseases continues to increase (Arias et al., 2022; Guthold et al., 2018), thus, to understand how each specific SB can impact health will assist health entities to provide more accurate recommendations, an endeavour of key importance in an industrialized, technologic world discouraging the need for PA. Besides that, this investigation can supply for further insights about the importance of measuring SB and PA by domain through a combination of accelerometers (objective assessments) and questionnaires (subjective assessments). Considering aging, and although this was not the focus of this research more free time after retirement may represent and additional peril for spending more time in leisure SB, in front of screens. However, more research is necessary, since the association of technology use and well-being in the elderly is unclear (Szabo et al., 2019) and, as cited before, the assessment of the SB domain is still less investigated.

6. Conclusion

Our data indicate that although SB has already been recognized as a harmful behavior for well-being and quality of life, future studies should focus on understanding the domain in which SB is accumulated. Thus, although the current recommendations for SB are "sit less" or “minimize time sitting in front of screens”, our findings suggest that these recommendations should be more domain-oriented depending on age group. For younger adults, the domain of SB that seems to be more harmful to well-being is the leisure context, whereas in adults, the occupational context is more harmful. However, this must be confirmed in future experimental studies.

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Chapter VII

Study 5: Sitting time and well-being and quality of life

O objetivo mais alto do artista consiste em exprimir na fisionomia e nos movimentos do corpo as paixões da alma.

Leonardo da Vinci

Chapter VII

Longitudinal changes in sitting time and impact on well-being and quality-of-life of sedentary workers. *[5]

Abstract

Sitting time (ST) in the occupational domain has been linked to reduced well-being and quality-of-life. However, studies investigating the longitudinal impact of reducing ST in these outcomes are scarce. We evaluated the impact of a 6-month sit-stand desk-based intervention on sedentary workers' well-being and quality-of-life. Independent and paired-sample T-tests were used to evaluate the differences between and within groups, and repeated-measures ANOVA was conducted to evaluate the effects of the intervention. Our analyses indicated that 13 participants out of 38 reduced ST (on average -72min/day [±40.0; p<0.001], while 25 participants slightly reduced or even increased ST (on average +36.7min/day [±40.3; p<0.001]). Both reducers and non-reducers had an improvement in quality-of-life scores, but only those who reduced ST improved subjective well-being (p=0.028). Although there was a larger statistical power within participants that reduced ST, no time*group interaction was found, thus the intervention failed to impact the targeted outcomes.

Key words: sedentary behavior; sitting-time; well-being; quality-of-life; intervention; work-related.

[5] Teno, S.C., Silva, M.N., Silva, H., Júdice, P.B. Longitudinal analysis in sitting time and impact on well-being and quality of life of sedentary workers. Published in Ergonomics Journal. https://doi.org/10.1080/00140139.2024.2441451.

1. Introduction

There has been a call for research that focuses on positive aspects of health, that is, not only understanding the disease and its treatment but instead focusing on the prevention side (Galinha & Pais-Ribeiro, 2005; Zhang & Chen, 2019). Thus, people's quality-of-life as well as their well-being have been key components of concern from the major international entities dedicated to improving health and development of population (*Who We Are*, 2023; The World Health Organization, 1995; United Nations Development Programme, 2023).

It has been empirically demonstrated that subjective well-being, that is, the way a person evaluates their life, including life and material satisfaction, lack of depression and anxiety, and positive mood and emotions (Diener, 1984; Diener et al., 1999), is related to and precedent of successful situations in various domains of a person's life through its main component, positive affect, including professional performance, health, and good relationships (Lyubomirsky et al., 2005). In cross-sectional, longitudinal, and experimental studies, well-being has been associated with self-perceived health, longevity, healthy behaviors, mental and physical illness (negatively), social connectivity, citizenship, and productivity (Diener, 2012; Diener et al., 2017; Diener & Chan, 2011; Diener & Seligman, 2004; Lyubomirsky et al., 2005). Moreover, in population terms, well-being is important because it serves as a global measure of a nation's success in meeting the needs, goals, and values of citizens (Diener & Seligman, 2004).

The term "quality-of-life" defined by The World Health Organization (WHO) refers to the individual's perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards, and concerns. It is a broad-ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships and their relationship to salient features of their environment (The World Health Organization, 1995). Both quality-of-life and subjective well-being are concepts interconnected to the WHO concept of health ("Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"), and therefore, it may be affected by all its determinants, that is, the social and economic environment, the physical environment, and the person's individual characteristics and behaviors (WHO, 2017).

From an individual point of view, one of the behaviors that can affect people's health and, consequently, their well-being and quality-of-life is sedentary behavior. Sedentary behavior is characterized by a series of activities in a sitting or reclining posture with low energy expenditure (≤ 1.5 metabolic equivalents [MET]), while awake (Tremblay et al., 2017). Its excessive accumulation has been associated with all-cause mortality, cardiovascular disease, type II diabetes, some types of cancer, reduced cognitive function, health-related quality-of-life, and depression (Katzmarzyk et al., 2019; Patterson et al., 2018; Saunders et al., 2020; Wang et al., 2019). An investigation that used an objective measure of sedentary behavior evaluation found that with office workers, the time at work (i.e., in the occupational domain) was the main contributor to prolonged and uninterrupted exposure to sedentary behavior and may be responsible for up to 82% of working hours (Parry & Straker, 2013) and 48.5% of weekly sedentary behavior (Lam et al., 2022). Sedentary behavior in the occupational domain has been linked to chronic diseases and mental health problems (Bailey, 2021), making this an important field for investigations in recent years.

Interventions to reduce sedentary behavior in the work environment can include environmental components (e.g., placement of sit-stand workstations), organizational components (e.g., motivating role of management), and/or individual components (e.g., coaching) and have shown significant results in reducing sitting time (ST), i.e., a sedentary behavior indicator. A recent systematic review with meta-analysis indicated that interventions targeting the physical environment can reduce ST by -89.83 min/day (95% CI -124.58 to –55.09; $p \leq 0.0001$) (Lam et al., 2022), which could contribute to reducing waist circumference and all-cause mortality risk and increasing high-density lipoprotein cholesterol (del Pozo-Cruz et al., 2018). However, few studies have investigated the effect of reduced ST on participants' quality-of-life and well-being, and the results are unclear. For example, in a cluster randomized control trial with 146 office workers by National Health Services (NHS), the intervention group that used a sit-stand workstation for 12 months and a series of daily reminders and strategies to stand up, reduced ST at three months (-50.62 min/workday, $p<0.001$) and at six months (-64.40 min/workday, $p<0.001$) compared with the control (that continued with usual practice). The groups were assessed at baseline at 3, 6, and 12 months, and compared with the control group, the intervention group had reduced daily anxiety at 6 and 12 months and scored better on the overall and in two domains of quality-of-life (psychological and environmental) at 6 and 12 months, indicating a positive effect of the intervention and that the effect may require at least 6 months to deliver results (Edwardson et al., 2018).

However, a similar intervention compared data of 756 desk-based public office employees from one of three conditions: 1. Intervention to reduce ST based on the theory of changed behaviors (smart work and life [SWAL] intervention); 2. SWAL intervention plus a sit-stand workstation; or 3. carried out with usual practice for the length of the study (Edwardson et al., 2022). The results indicated a significant reduction in daily ST at 12 months (SWAL -22.2 min/day, $p=0.003$ and SWAL plus desk -63.7 min/day, $p<0.001$) compared with the control group but did not reflect significant changes in the well-being and quality-of-life of participants at 12 months. Thus, considering the above we aim to evaluate the impact of ST reduction on the subjective well-being and quality-of-life of sedentary workers.

2. Method

2.1. Trial design

This work is part of a cluster randomized controlled trial (RCT) with the aim of evaluating the change in sedentary patterns (i.e., quantity and accumulation pattern) resulting from the introduction of a health-enhancing environmental modification (i.e., sit-stand desk) in the workplace, compared to a control group after 6 months of intervention – Stand up for healthy aging (SUFHA). Its protocol was published previously (Júdice et al., 2023). In summary, a two-arm (1:1), superior parallel-group cluster crossover RCT was performed to evaluate the SUFHA intervention. For this investigation, in addition to main analysis (i.e., main groups comparisons), a longitudinal analysis was performed to assess the ST reduction, with or without of the use of a sit-stand desk. All participants provided written informed consent and the project was approved by the ethics commission of the Faculty of Physical Education and Sport at the University of Lusófona in Lisbon (Approval number D0522). The investigation was conducted in accordance with the Declaration of Helsinki for Human Studies.

2.2. Setting and participants

During November 2022, the office-based workers of a Portuguese university were contacted via university advertisements (e.g., posters, banners, invitation emails) and 50 employees showed interest in participating in the trial. However, after the application of the inclusion/exclusion criteria, only 40 were able to be included in the trial and 39 were included (one participant withdrew from the study due to health reasons). Participants were divided in intervention group (IG) and control group (CG), and for the current paper participants were further divided into two groups according to the criteria of ST reduction of at least 30 min/day (i.e., ST reducers) or non-reducers if they reduced ST by less than 30 min/day or even increased ST. This value was chosen according to previous literature indicating that replacing 30 minutes of ST for physical activity at any intensity was associated with a lower risk of several indicators of cardiovascular disease and all-cause mortality (del Pozo-Cruz et al., 2018) and also with lower levels of depressive symptoms (Sadarangani et al., 2023).

2.3. Eligibility criteria

The inclusion criteria for SUFHA trial were working at least 0.6 full-time, being more than 20 years old, and spending at least 70% of a working week performing desk-related activities. Participants would not be able to participate if they already use a sit-stand desk, if they do not have a personal space where the sit-stand desk could be assembled, or if they had musculoskeletal disorders/health conditions, making it impossible to work in a standing posture.

2.4. Intervention/exposure

In short (check study protocol for further detail (Júdice et al., 2023)), all participants received a psychoeducational session concerning the independent benefits of reducing and interrupting ST with standing and the risks of accumulating sedentary behavior. Afterwards, while 20 participants were provided the opportunity to work on a sit-stand desk (intervention group [IG]) for 6 months, the other 19 remained on a traditional sitting desk (control group [CG]), being randomly allocated. The participants who used a personal sit-stand desk were allowed to switch between sitting and standing positions and set their desk height freely during working hours. To secure desk use, participants were also given the following: (i) a demonstration on how the sit-stand desk worked; (ii) information on the correct ergonomic posture; and (iii) guidance on gradually building up standing time, as evidence suggests that behavioral feedback and regular contact with research staff are key elements of change. In addition, to enhance motivation and self-regulation for internalizing the new routines of breaking up ST, these participants were provided motivational nudges throughout the period of exposure (i.e., monthly visits by the researchers for check desk functioning and informative videos and infographics with the evolution of the results).

2.5. Measures

Demographic data: Information on age, sex (male, female, other), education (high school, bachelor’s degree, master’s degree, Ph.D. degree), perception of financial status (very difficult, sufficient for requirement, comfortable), occupation (services, management/administrative, academic/services, financial services, other), and current smoking status (never, former, occasionally, current) were self-reported. In addition, the presence of chronic disease (yes/no), use (yes/no), and type of medication were also self-reported.

Physical activity: Information about physical activity was self-reported as two categories ("Do you usually practice structured physical activity, for example, running, walking, exercise in the gym, dancing or sporting activities?" – yes/no).

Anthropometric measures: Participants were weighed while wearing minimal clothes and without shoes on an electronic scale (TANITA BC-601 scale). Height was measured with a stadiometer (Seca, Hamburg, Germany). Body mass index (BMI) was calculated as body mass (kg)/height^2 (m). Waist circumference was measured with the participants in a standing position over the naked skin.

2.6. Main outcome measures

Sitting time (ST) was assessed with an ActivPAL inclinometer/accelerometer monitor (model ActivPAL4; PAL Technologies Ltd., Glasgow, UK) while using the CREA (v1.3) classification algorithm that allows us to distinguish non-wear, lying/sitting, standing, cycling, seated during transport, and stepping time as well as the number of steps. Participants used the device on their right thigh 24 h/day for 7 days at baseline, repeating this assessment at the end of the intervention (after 6 months).

Participants' quality-of-life was assessed by the EUROHIS-QOL 8-item instrument (Buratta et al., 2003). The EUROHIS-QOL-8 is a measure of quality-of-life composed, as the name implies, of eight items and developed from the generic instruments WHOQOL-100 (The World Health Organization, 1995) and WHOQOL-Bref. Response adequate to each statement/item, i.e., the first item (How would you rate your quality-of-life?) has a response from 0 ("very bad") to 4 ("very good"), with 1 being "bad", 2 being "not good or bad", and 3 being "good". For items 3 and 7, the answers range from 0 ("nothing") to 4 ("completely"), and the remaining items range from 0 ("very unsatisfied") to 4 ("very satisfied"). The result is a global index, calculated from the sum of the eight items, and a higher value corresponds to a better perception of quality-of-life. The results range from 0 (worse quality-of-life) to 32 (better quality-of-life). In the pilot study, the EUROHIS-QOL-8 had a Cronbach's α of.78 (Buratta et al., 2003), and in the initial field study, which involved a sample of 10 countries, it presented a Cronbach's α of.83 (Schmidt et al., 2006).

The participant's subjective well-being was assessed by The World Health Organization Five Well-being Index (WHO-5) (Topp et al., 2015), which compresses 5 items, evaluated on a 6-point Likert scale ranging from 0 ("never") to 5 ("all the time"). The questionnaire only contains positively phrased items: (1) 'have felt cheerful and in good spirits', (2) 'I have felt calm and relaxed', (3) 'I have felt active and vigorous', (4) 'I woke up feeling fresh and rested' and (5) 'My daily life has been filled with things that interest me'. The respondent was asked to rate how well each of the 5 statements applied to him or her when considering the last 14 days. Each of the 5 items is scored from 5 (all of the time) to 0 (none of the time). The raw score therefore theoretically ranges from 0 (absence of well-being) to 25 (maximal well-being). The WHO-5 was evaluated as a psychometrically sound brief measure with non-invasive questions that tap into the subjective well-being of respondents (Sischka et al., 2020).

2.7. Sample size

Considering the type of investigation (clustered RCT) and main outcome of the intervention (i.e., ST) while using an effect size of 0.80, the total number of participants for between-group analyses, with a power of 0.80 and a significance level of 0.05 (two-tailed test), would be 34 participants.

2.8. Randomizing, allocation, and blinding

Cluster randomization using a list randomizer (www.random.org) was performed by a researcher not involved in recruitment or data collection. The randomization and group allocation process were performed using the different sites as the unit of randomization to reduce the risk of the intervention being contaminated. Baseline assessment was taking place prior to randomization; thus, at this point, participants and field work staff were unaware of group allocation. After baseline, due to the nature of the intervention, it was not possible to blind participants or staff.

2.9. Statistical methods

Continuous variables were presented as mean and standard deviation. The T-test for independent samples was used to assess the differences between groups at baseline. The paired sample T-test was used to evaluate the differences within group pre-post 6 months.

Repeated measures ANCOVA, with time (baseline, 6-months follow up) as within-subject factor, the intervention group as between-subject factor, while exploring the time*group interaction effect was conducted to evaluate the effects of the intervention, adjusted for the use of anxiolytics or antidepressants and the practice of structured physical activity. In the second analysis the same was performed but with the dichotomous factor that differentiates the participants that reduced ST and the non-reducers as the between-subject factor. Repeated measures ANCOVA was conducted to evaluate the effects of ST reduction on the outcomes, adjusted for the use of a sit-stand desk. Statistical significance was set at $p < 0.05$. All assumptions of normality and equality of variances were observed. Statistical analyses were conducted using Jamovi software, version 2.2.5.0.

3. Results

From the 39 participants who completed the study, one participant was not included in the analyses due to pregnancy during the intervention period, so 38 participants were considered in the final analyses. A description of the participants is exhibited in Table 1 according to randomized groups.

Table 1: Baseline characteristics according to randomized groups: usual practice (control group) and SUFHA intervention (intervention group). Values are means (standard deviations) unless stated otherwise.

Characteristics	CG	IG	Total	T-Test independent samples
Individual level	**(n=19)**	**(n=19)**	**(n=38)**	
Age (years)	42.2 (9.5)	45.7 (5.9)	44.0 (8.0)	0.191
N° (%) women	14 (73.3%)	15 (78.9%)	29 (76.3%)	
N° (%) men	5 (26.7%)	4 (21.1%)	9 (23.7%)	
Body mass index (kg/m^2)	30.5 (7.4)	27.3 (6.1)	28.9 (6.9)	0.165
Waist circumference (cm)	90.2 (15.4)	83.3 (13.3)	86.8 (14.6)	0.152
Physical behaviors				
Sitting time (min/day)	475.8 (130.4)	471.3 (71.5)	473.6 (103.7)	0.896
Total n° steps per day	6519.2 (2239.7)	7992.7 (2500.67)	7256.0 (2457.6)	0.064
Psychometric measures				
Quality-of-life score (0 to 32 pts)	19.0 (5.1)	20.6 (3.2)	19.8 (4.3)	0.252
Subjective well-being (0 to 25 pts)	11.9 (5.9)	14.8 (4.2)	13.4 (5.2)	0.086
Smoking status (%):				
Current	21.1%	5.2%	13.2%	
Former	15.8%	47.3%	31.6%	
Occasionally	5.3%	10.4%	7.9%	
Never	57.9%	36.8%	47.4%	
Perception of financial situation				
Very difficult	5.3%	15.0%	10.1%	
Sufficient for requirements	42.1%	60.0%	51.1%	
Comfortable	52.6%	25.0%	38.8%	
Education (%):				
Ph.D. Degree	15.8%	5.2%	10.5%	
Master's Degree	15.8%	10.4%	13.2%	
Bachelor's Degree	31.6%	63.1%	47.4%	
High School	36.8%	21.0%	28.9%	
Occupation (%):				
Academic/Administrative Services	26.3%	52.6%	39.5%	

Management/Administrative Services	15.8%	21.0%	18.4%
Financial Services	15.8%	0.0%	7.9%
Other	42.1%	26.3%	34.2%
Chronic Disease			
Yes	21.1%	21.1%	21.1%
No	78.9%	78.9%	78.9%
Type of medication			
Hypothyroidism	5.2%	0.0%	2.6%
Antihistamine	5.2%	0.0%	2.6%
Metabolic disease	10.4%	5.2%	7.8%
Metabolic disease + Anxiolytics	5.2%	0.0%	2.6%
Anxiolytics or Antidepressants	31.5%	0.0%	15.7%
Gastric reflux and asthma	0.0%	5.2%	2.6%
Medication			
Yes	57.9%	21.1%	39.5%
No	42.1%	78.9%	60.5%
Structured exercise			
Yes	31.5%	57.8%	44.7%
No	68.4%	42.2%	55.3%

Abbreviations: CG, control group; IG, interventional group.

The comparisons within and between groups from baseline to 6 months are presented in Table 2 for the outcomes of interest.

Table 2: Changes in outcomes at 6-months follow-up between intervention and control groups.

	Mean change from baseline (SD/95% CI)		**Time*group interaction effect**
	CG (n=19)	**IG (n=19)**	**P value**
Physical behaviors			
Sitting time (min/day)	8.63 (± 75.6)	-9.91 (± 54.7)	0.433
Total n° steps per day	613.0 (± 2053)	-90.1 (± 1916)	0.264
Psychologic measurements			
Quality-of-Life (score)	1.52 (0.46 to 2.59) *	2.15 (0.85 to 3.45) *	0.628
Subjective well-being (score)	1.31 (-0.96 to 3.59)	2.21 (0.45 to 3.96) *	0.526

Abbreviations: CG, control group; IG, interventional group.
Note: * means significant time effect within group based on the paired-sample T test. All analyses for psychological measures were adjusted for the use of anxiolytics or antidepressants and the practice of structured physical activity.

The comparisons within and between groups from baseline to 6 months indicated no significant interaction for the main outcome - ST (p=0.433). Nevertheless, there was a significant increase in the quality-of-life score within both groups and a significant increase in subjective well-being in the IG, although the difference was not significant between groups. Thus, when looking at the raw data, we could observe a reduction in ST in some participants in both groups, indicating that standing desk use did not influence ST, but the previous psychoeducational session regarding the benefits of reducing ST and their risks could have influenced the participants.

To further explore the results, we carry out an exploratory analysis, with those who, regardless of the group to which they belonged, had, or did not have a reduction in ST after the intervention of at least 30 min/day (called here ST reducers [↓ST] or non-reducers [+=ST]). This value was chosen according to previous literature indicating that replacing 30 min of ST for physical activity at any intensity was associated with a lower risk of several indicators of cardiovascular disease and all-cause mortality (del Pozo-Cruz et al., 2018) and with lower levels of depressive symptoms (Sadarangani et al., 2023). The baseline characteristics are described in Table 3 (according to the criteria of reducing ST), and the changes in the outcomes after 6 months between the two groups are depicted in Table 4.

Table 3: Baseline characteristics according to ST reducers and non-reducers. Values are means (standard deviations) unless stated otherwise.

Characteristics	↓ST	+=ST	Total	T-test independent samples
Individual level	**(n=13)**	**(n=25)**	**(n=38)**	
Age (years)	44.3 (6.5)	43.8 (8.7)	43.9 (7.9)	0.856
N° (%) women	9 (69.2%)	20 (80%)	29 (76.3%)	
N° (%) men	4 (30.7%)	5 (20%)	9 (23.7%)	
Body mass index (kg/m^2)	28.9 (5.5)	28.9 (7.6)	28.9 (6.9)	0.972
Waist circumference (cm)	87.4 (11.8)	86.4 (16.2)	86.8 (14.6)	
Physical behaviors				
Sitting time (min/day)	457.6 (108.8)	504.3 (89.2)	473.6 (103.7)	0.856
Total n° steps per day	6589.2 (2501.6)	7445.1 (2464.4)	7256.0 (2457.6)	0.518
Psychometric measures				
Quality-of-life score (0 to 32 pts)	18.9 (4.0)	20.2 (4.5)	19.8 (4.3)	0.367
Subjective well-being (0 to 25 pts)	12.4 (5.0)	13.8 (5.4)	13.4 (5.2)	0.453
Smoking status (%):				
Current	15.3%	12.0%	13.2%	
Former	30.7%	32.0%	31.6%	
Occasionally	0.0%	12.0%	7.9%	
Never	53.8%	44.0%	47.4%	
Perception of financial situation				
Very difficult	7.6%	12.0%	10.1%	
Sufficient for requirements	46.1%	52.0%	51.1%	
Comfortable	46.1%	36.0%	38.8%	
Education (%):				
Ph.D. Degree	15.3%	8.0%	10.5%	
Master's Degree	15.3%	12.0%	13.2%	
Bachelor's Degree	53.8%	44.0%	47.4%	

High School	15.3%	36.0%	28.9%
Occupation (%):			
Academic/Administrative Services	30.7%	44.0%	39.5%
Management/Administrative Services	23.0%	16.0%	18.4%
Financial Services	0.0%	12.0%	7.9%
Other	46.1%	28.0%	34.2%
Chronic Disease			
Yes	15.3%	24.0%	21.1%
No	84.7%	76.0%	78.9%
Medication			
Yes	5	10	39.5%
No	8	15	60.5%
Type of medication			
Hypothyroidism	0%	4.0%	2.6%
Antihistamine	0%	4.0%	2.6%
Metabolic disease	7.6%	8.0%	7.8%
Metabolic disease + Anxiolytics	0%	4.0%	2.6%
Anxiolytics or Antidepressants	15.3%	16.0%	15.7%
Gastric reflux and asthma	7.6%	0.0%	2.6%
Structured exercise			
Yes	38.4%	48.0%	44.7%
No	61.5%	52.0%	55.3%
Did they use a sit stand desk (N) %			
Yes	7 (53.8%)	12 (48.0%)	19 (50.0%)
No	6 (46.1%)	13 (52.0%)	19 (50.0%)

Abbreviations: ↓ST, sitting time reducers; +=ST, non-reducers.

Table 4: Changes in the outcomes at the 6-month follow-up between ST reducers and non-reducers.

	Mean change from baseline (SD/95% CI)				**Time*group interaction effect**
		Effect size Cohen's d		**Effect size Cohen's d**	**P value**
	↓ ST		**+= ST**		
Physical behavior					
Sitting time (min/day)	- 72.4 (± 40.0) **	1.81	36.7 (± 40.4) **	0.90	0.837
Total Steps per day	653.7 (± 2413)	0.27	57.5 (± 1752)	0.03	0.644
Psychologic measurements					
Quality-of-Life (score)	3.23 (2.11 to 4.34) **	1.58	1.12 (0.08 to 2.15) *	0.42	0.775
Subjective well-being (score)	3.61 (2.79 to 4.43) *	2.41	0.80 (-1.24 to 2.84)	0.15	0.912

Abbreviations: ↓ST, sitting time reducers; +ST, non-reducers.
Note: * means significant time effect within group based on the paired-sample T test with $p<0.05$. ** means significant time effect within group based on the paired-sample T test with $p<0.001$. All analyses were adjusted for the use of a sit-stand desk.

Our second analysis findings indicate that both reducers and non-reducers improved their quality-of-life scores, but the reducers improved more than non-reducers (p<0.001 [Cohen's d: 1.58 – very large (Sullivan & Feinn, 2012)] *vs* p=0.044 [Cohen's d: 0.42 - small], respectively); however, although there was a larger statistical power within participants that reduced ST, between groups, there was no time*group interaction. Also, only those who reduced ST significantly improved subjective well-being (p=0.028 [Cohen's d: 2.41- very large]).

4. Discussion

The findings from our intervention in the work environment showed no differences between the CG and IG from baseline to 6 months for ST (p>0.05). A previous investigation also failed to reduce ST through the use of sit-to-stand desk (Renaud et al., 2020), despite the majority of the literature indicating effectiveness of this type of intervention to reduce ST (Prince et al., 2014). Although not the main goal here, briefly, the authors attribute the failure to decrease in the usage of the sit-stand desk throughout the intervention period (i.e., based on the self-reported results from a monthly questionnaire), which can be justified not only by the lack of novelty effect as time passes, but also by a higher work flux that participants reported in the final month of the intervention.

In this investigation, our aim was to evaluate the effect of the reduction in ST on quality-of- life and subjective well-being, regardless of the results found among groups. Our results indicated an increase in the quality-of-life score in both groups from baseline to 6-month follow-up (CG: p=0.012 and IG: p=0.040) and an increase in subjective well-being in the IG (p=0.024), despite no effect of the intervention on ST and no time*group interaction for both, quality-of-life score (p=0.628) and subjective well-being (p=0.526). Thus, we carried out a secondary analysis with those who, regardless of the group to which they belonged, had, or did not have a reduction in ST of at least 30 min/day. The main findings indicated that 13 participants out of 38 reduced ST by at least 30 min/day, with an average reduction of 72.4 min/day (p<0.001) compared to baseline, while 25 participants increased ST on average 36.7 min/day (p=<0.001), independently of the use or non-use of sit-stand desk.

Regarding ST, our findings are not aligned with those achieved by Edwardson et al. (2022), who performed a 12-month intervention with one arm grounded in social cognitive theory, organizational development theory, habit theory, self-regulation theory, and relapse prevention theory, and another arm identical one, but with the use of height-adjustable desks, versus a control group. Overall, both interventions (with [-63.7 min/day, p<0.001] and without a height adjustable desk [-22.2 min/day, p=0.003]) was effective in reducing daily ST, although the arm with a sit-stand desk was three times more effective at reducing ST than the arm without sit-stand desk use. In this case, only the participants who used a sit-stand desk achieved more than 30 min/day of ST reduction, whereas in our investigation, this reduction was independent of the sit-stand desk usage.

One of the reasons that may have led to the reduction in ST in our investigation may have been the initial session on the harmful effects of sedentary behavior, in which all participants were exposed to several health indicators that were impaired by the accumulation of ST. Another factor that may have contributed to this reduction in some people is that among the participants who reduced their ST, 61.5% reported not performing structured exercise, versus 52.0% of those who did not reduce, so the ST reducers may have felt a greater need to compensate their physical inactivity with more standing while at work.

Regarding the main purpose of this investigation, the results indicated that both (reducers and non-reducers) improved their quality-of-life scores, but the reducers improved more than non-reducers with larger effect size ($p<.001$ [Cohen's d: 1.58] vs $p=0.044$ [Cohen's d: 0.42], respectively); however, although there was a larger statistical power within participants that reduced ST, between groups, there was no time*group interaction. In addition, only those who reduced ST had significantly improved subjective well-being ($p=0.028$ [Cohen's d: 2.41]); however, again, between groups, there was no significant difference, indicating a low impact of reducing ST on both outcomes.

One of the reasons why there may not have been differences in the quality-of-life and subjective well-being between those who reduced and those who did not reduce ST may have been the time of the intervention (6 months), which may not have been able to capture the changes that the reduction of ST could cause on both. One of the few studies that investigated the effect of ST reduction on quality-of-life and that showed improvement in some aspects (psychological and environmental) had a duration of 12 months (Edwardson et al., 2018), and the results were significant at 6 and 12 months, increasing progressively. In addition, differently of our investigation, were provided in addition to the sit-stand desk, coaching sessions, and other personal strategies to encourage regularly break up sitting (a vibration cushion with Bluetooth with sync data with a mobile phone to regularly break up sitting to provide the participant with real-time feedback). This resulted in a daily ST reduction of -59.3 min/day at 6 months ($p<0.001$) and -82.3 min/day at 12 months ($p=0.001$), also increasing progressively, which can have been more effective improving some aspects of quality-of-life (for example, their self-perception of health or energy).

Another point that can be raised is that even among people who reduced their ST, the physical activity monitoring device used (number of steps) indicated an average increase of 653.7 steps per day, which diluted in the hours of the day, does not mean an amount of physical activity that is enough to change any health parameter that can significantly improve the perception of health or physical fitness (Washburn & Ihm, 2021). In addition, our total sample consisted of people with reasonably high values (19.8 out of 32) of quality-of-life score; for example, all of them were employed and reported reasonably good health (39.5% reported medication use), only 10.1% reported a "very difficult" financial situation, and 71.1% had at least a bachelor's degree, and almost half of our sample performed structured physical activity (44.7%), leaving little margin for improvement. In addition, only 13.2% were current consumers of tobacco and did not present obesity, factors that, if present (more tobacco consumers and obesity), could reduce the perception of well-being, since are associated with risk of depression and mental health problems (Abiri et al., 2022; Wu et al., 2023). Other studies focused on the effects of ST reduction on symptoms of anxiety or stress/fatigue and productivity (Edwardson et al., 2018; Falk et al., 2022), which is outside the scope of our research that focused on the positive aspects of mental health, thus comparison with these studies is problematic.

5. Strength and limitations

This study has many strengths, including the objectively measured data for ST and the use of validated questionnaires for the main outcomes. In addition, our retention of participants (0% drop-out) and the proposal of investigation in a real-life office context are also strengths. Nevertheless, there are some limitations worth noting. First, our intervention consisted of office workers at a university, which can be more open to accept modifying their workstation than other office workers; thus, our results may not apply to office workers in other types of industry jobs with different work schedules and office space layouts. Secondly, our sample was calculated considering the primary outcome (ST); thus, we may have been underpowered for the secondary outcomes, principally those linked to psychological measures. Future interventions should focus on strategies that not only provide adjustable desks but also include organizational and personal components for greater participant engagement. Thus, it will be possible to confirm the impact that ST reduction can have on subjective well-being and quality-of-life in medium to long term interventions.

6. Conclusions

The exposure to a psychoeducation session and/or contextual modification by a sit-stand desk in the workplace for reduction of ST (19 with sit-stand desk and 19 without a desk) was effective for 13 out of 38 participants (average reduction of ST of -72 min/day). The ST reducers improved their quality-of-life and subjective well-being scores more than non-reducers, but these improvements were not statistically different from the ones attained by non-reducers. Future longitudinal investigations are needed to confirm these results in a larger scale.

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Chapter VIII

General results and conclusion

Quanto menos comes, bebes, compras livros e vais ao teatro, pensas, amas, teorizas, cantas, sofres, praticas esportes, etc., mais economizas e mais cresce o teu capital. És menos, mas tens mais. Assim todas as paixões e atividades são tragadas pela cobiça.

Karl Marx

Chapter VIII

1. General results and conclusion

The inspiring question – Does context matter? What are the relations between several domains of PA and SB with SBW and HRQoL? – was the center of the present thesis and influenced its approach, methodology, results, and conclusions. The main goal of this work was to understand how accumulated time in each behavior's domain can be associated with well-being measures and HRQoL.

Considering the importance of SWB and HRQoL for health, job performance, good relationships, social connectivity, citizenship, and longevity, it is fundamental to the public health agenda to comprise how each behavior can impact SWB, and which domains can be more harmful, and for which age range or gender. This information is relevant, as the current public guidelines for PA are centered on the weekly volume and intensity required to entail health benefits without specifying the domain in which this PA must be accumulated. This gap was mentioned in the last World Health Organization 2020 Guidelines on Physical Activity and Sedentary Behavior (Bull et al., 2020), indicating that we still have a lot of way to go in the field of PA. Furthermore, we aimed to approach this theme from a positive perspective (i.e., not focusing on the relation with the evaluation risk, incidence, or symptoms of depression or anxiety – the other spectrum of well-being) but on the relation with positive markers of mental health.

1.1. General results

The main conclusions from Chapter III, carried out through a systematic review to gain a deeper understanding of the associations between time spent in different domains of PA and SB and its impact on several indicators of mental health and illness in adults, were:

- In experimental studies (6), comparing against the control group, the reduction in occupational SB reduced anxiety at 6 and 12 months and increased two domains (psychological and environmental) of QoL in the same period (Edwardson et al., 2018). Regarding PA, in experimental studies, LTPA increased the QoL, reduced stress at work (Fang et al., 2019), reduced state and trait of anxiety, and improved mental health (Zheng et al., 2018). Furthermore, LTPA improves vitality, control, and concern about pain (Jakobsen et al., 2017; Zheng et al., 2018). In a study that assessed changes in mental health by boosting people to be more physically active on their commute to work, TPA showed positive associations with mental health in the group that became more active in commuting to work when compared to the control group, besides positive changes in four subcomponents of the SF-36 (physical functioning, mental health, vitality, and general health). In addition, the participants who took a bike path (one of the ways to increase TPA in the intervention group) presented more changes in QoL than participants who used public transport and walked (Neumeier et al., 2020). Regarding OPA evaluated in the community garden, no differences were found in mental well-being compared with the control group after one year of follow-up (Tharrey et al., 2020).

- In longitudinal studies focusing on PA (3) (Changwook Kim et al., 2021; Sheikh et al., 2018), two studies with 9 and 13 years of follow-up found that LTPA increased psychological, emotional, and social functioning and reduced psychological distress over time, but OPA and TPA increased the risk of depression after six years of follow-up (Teychenne et al., 2017). Conversely, leisure-time SB (watching TV) was associated with higher depressive symptoms at baseline (cross-sectionally), while mentally active SB (e.g., reading or computer use) was associated with lower depressive symptoms. However, when considering the follow-up (2 years later), there was no increase in depressive symptoms associated with any type of SB (Hamer & Stamatakis, 2014).
- In cross-sectional studies (15), LTPA was significantly associated with well-being (Mason et al., 2016), lower depression symptoms, anxiety, and psychological distress (Chu et al., 2018; De Cocker et al., 2021; Fernandez-Montero et al., 2020; Jo et al., 2021; Marques, Peralta, Gouveia, et al., 2020; Siefken et al., 2019; Werneck et al., 2020, 2021). The TPA was positively associated with well-being, distress reduction, and less stress symptoms (De Cocker et al., 2021; Mason et al., 2016; Werneck et al., 2020) in some investigations, mainly in Europe, Australia, and Brazil (just when performed in high volume [60-89 min/week]). However, it was also associated with a higher risk of depression among women living in socioeconomically disadvantaged neighborhoods in Australia (Teychenne et al., 2017). Leisure-time SB was negatively and significantly associated with well-being (Atkin et al., 2012), with increases in depressive symptoms, anxiety, and perceived stress (Felez-Nobrega et al., 2020; Werneck et al., 2019), but in one investigation (Chu et al., 2018), no associations were found in this regard, so less consistent results for SB seem to exist.

The main results from Chapter IV carried out to analyze the potential of several health correlates to be potentially harmful vs. improve life satisfaction (i.e., a measure of SBW), using cross-sectional data from an academic environment were:

- Among all putative indicators included in the model, negative correlates of LS were SB in the occupational domain, a low (vs. high) perceived financial situation, and performing IPA (vs. during leisure-time). On the other hand, higher age emerged as a positive correlate for LS. Thus, through our data, we reinforced the necessity for governments and politicians to keep boosting their population PA levels and reducing the SB, allowing individuals to have more leisure-time and perform this PA outside their jobs, domestic tasks or commuting. Besides that, although SB is harmful for health, those who accumulate this behavior in their occupational times seem to reduce their LS, as do those who find themselves in a compromised financial situation.

The main results from Chapter V, where the goal was to identify the differences in health indicators between adults who attain PA recommendations through LTPA versus those who achieve these recommendations through IPA, and to investigate these differences by sex at birth:

- Those active in their leisure-time spent significantly less time in leisure-time SB, performed more vigorous intensity PA, had greater energy expenditure per week, had higher adherence to the Mediterranean diet, and scored better in the physical component of HRQoL (all $p<0.05$). However, when stratified by sex, the advantages of being active in the leisure-time changed considerably. Among males, we can observe that the ones who were active in the leisure-time had significantly more vigorous PA (+180.0 min/week), higher weekly energy expenditure (1067 METS/week) and were less sedentary in the leisure-time (-94 min/day), when compared with those active through IPA. Alternatively, the data from women indicated that those who were active in the leisure-time had higher scores in the physical component of the SF-12 (+1.0), greater adherence to the Mediterranean diet (+2.89), and more time in vigorous PA (+120 min/wee) than those active through IPA (all $p<0.05$). In contrast, only the women active in IPA had significantly more time in moderate PA (+90 min/day). Thus, our data suggest that the PA performed in leisure-time promotes a healthier profile, potentially with a more important role in reducing the risk of chronic diseases than IPA, both in men and women but with different outcomes. The only difference found in women active in IPA was the display of more time in moderate-intensity PA (+90 min/week;

p=0.002), unlike men who had more 30 min/week (p=0.616). Since people considered active in IPA reported not performing structured PA, this difference is likely explained by the recognized more extensive participation of women in activities related to household and family care.

The main results from Chapter VI, which investigated the associations between SB from three different domains with PWB, GLS, and HRQoL in different age groups, were:

- After the adjustment for PA, sex, BMI, smoking history, chronic disease status, financial perception, quality and duration of sleep, leisure-time SB was negatively related to PWB in younger adults (18 to 24 years old). However, in adults (25 to 64 years old), occupational SB was negatively related to GLS and the mental component of QoL. In this case, our findings highlight the idea that not all SB is built the same and that future strategies to reduce SB from people's lives must target specific domains of SB according to the age group when aiming to improve well-being and QoL.

Finally, the main results from Chapter VII, which evaluated the longitudinal impact of the reduction of ST in the workplace (occupational domain) on sedentary workers' well-being and QoL through six months, were:

- The comparisons within and between groups from baseline to six months indicated no significant interaction for the primary outcome – sitting time (p=0.433) when the primary groups were considered. However, to further explore the results, we carry out an exploratory analysis with those who, regardless of the group to which they were assigned, had or did not have a reduction in ST at six months of at least 30 min/day (called here ST reducers [↓ST] or non-reducers [+ST]). Thus, we found a ST reduction for 13 out of 38 participants (average reduction of ST of -72 min/day (p<0.001). Consequently, our second analysis indicated that both ST reducers and non-reducers improved their QoL scores, but the reducers improved more than non-reducers (p<0.001 [Cohen's d: 1.58 – very large vs p=0.044 [Cohen's d: 0.42 - small], respectively); however, although there was a larger statistical power within participants that reduced ST, between groups, there was no time*group interaction. Also, only those who significantly reduced ST improved SBW (p=0.028 [Cohen's d: 2.41- very large]). We concluded that the exposure to a psychoeducation session and contextual modification by a sit-stand desk in the workplace for reduction of ST (19 with a sit-stand desk and 19 without a desk) was effective for part of the sample (13 out of 38 participants) and that ST reducers improved their QoL and SWB more than non-reducers. However, these improvements were not statistically different from the ones attained by non-reducers.

1.2. General conclusions

The main results from this thesis demonstrate that the domain where PA and SB are enacted plays an essential role in their impact on SWB and HRQoL, with the leisure-time and the occupational time presenting more prominence.

Regarding PA, one important finding is that it is not always positively associated with mental health measures since our results indicate that IPA (i.e., any activity that is part of one's daily living that is not done with the purpose of recreation or health), can reduce well-being through the increase of the chance for mental disease (as seen in chapter III) or being negatively associated with LS (as seen in chapter IV) or still, do not effectively contribute to general health (as seen in chapter V).

Evidently, physical inactivity is a pressing issue on the public health agenda, and we agree with the main health entities that the population needs to be active in their everyday life and commuting (for example, in the WHO campaign: "Every step counts" (*Every Move Counts towards Better Health – Says WHO*, 2020), however, when it comes to well-being and HRQoL, the LTPA must be prioritized, especially in a moment where the prevalence of mental diseases is higher than ever («Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019», 2022).

Previous studies have already raised this topic. A consensus statement from Sports Medicine Australia and the Australian Psychological Society (Vella et al., 2023) provided guidance to practitioners on the ways that PA can be promoted to maximize mental health benefits and highlighted the importance of PA being performed, at least in part, in leisure-time.

There are several definitions of leisure-time (Stebbins, 2018; Tokarski & Zarotis, 2020), however, the most up-to-date present leisure-time as a positive definition, but generally as time out of the work with subcategories or subdivisions. Newman, Diener & Tai (Newman et al., 2014) propose leisure as an amount of activities/time spent outside the mandatory work hours and/or engaging in leisure as subjectively defined. Besides that, according to the authors, leisure time involves how leisure is structured by time or activity (e.g., how many hours a person has out of work); and the subjective perception, to emphasize how individuals perceive themselves to be engaging in leisure time (e.g., some people can consider physical exercise as leisure and others as work, like athletes).

Kolesárova K. (Havlík, 2017) divides time into working and non-working time (Figure 1). Non-working time (i.e., time after work) is further divided into free and bound time. The bound time can include unpaid and necessary activities which people perform out of interest or free will (e.g., ensuring the running of the household and transport to work). On the other hand, in free time, relaxed activities, socializing, listening to music, arts, physical activities, and other hobbies can be included. Other authors classify leisure activities as focused on how the activities are, differentiating active activities (such as recreational sports) from passive activities (such as watching television or listening to music) (Holder et al., 2009).

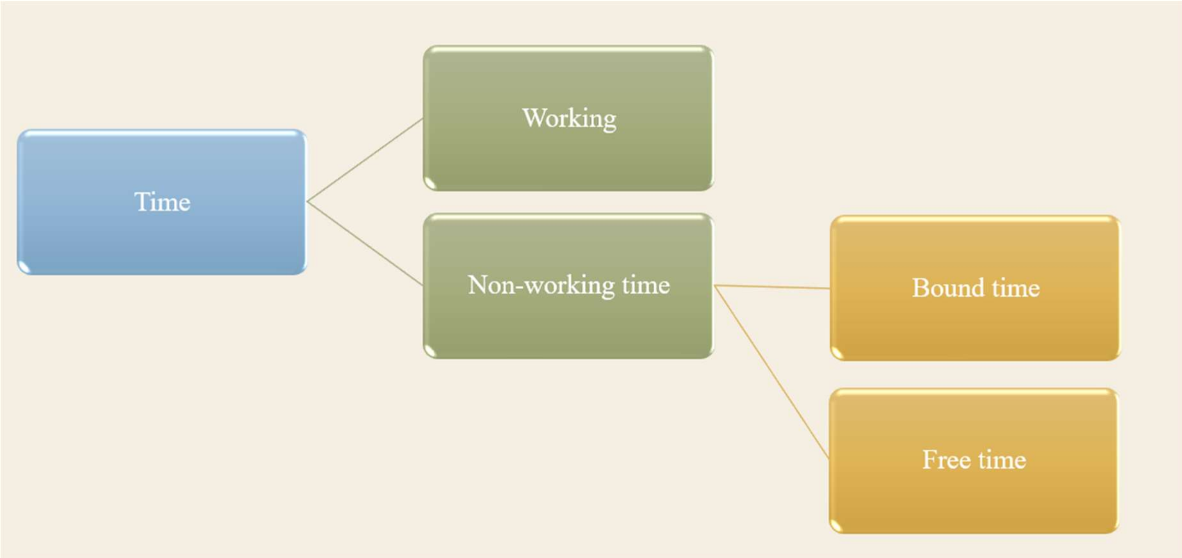

Figure 1: Time division by the Kolesárova K. (2017)

The positive relation between leisure-time and mental health, SWB, and HRQoL has been well-established in the literature through several study designs and among different populations (Fancourt et al., 2021). These relations can be explained by more than 600 mechanisms of action through psychological processes (i.e., affective states, building resilience, developing a sense of self, supporting individual personal transformation, helping individuals to flourish), biological processes (leisure activities can activate mechanisms within the endocrine, immune, and central nervous systems), social processes (i.e., mechanisms relating to social activity and social relationships), behavior processes (leisure engagement can lead to changes in behavioral mechanisms such as those relating to the development of habits), and health-related (engagement with leisure can lead to individual engagement in healthy behaviors, and reduced engagement in unhealthy behaviors) (Fancourt et al., 2021). However, these mechanisms that promote well-being are related to voluntary activities, not employment responsibilities that are engaged during free time, which are predominantly for enjoyment. Thus, it is comprehensive that LTPA is related to SWB and HRQoL in our research and does not IPA, although the physiological mechanisms (like functioning of the hypothalamus-pituitary-adrenal axis (Mahindru et al., 2023) or even the energy expenditure, that could be the same in both domains. Furthermore, the DRAMMA model (detachment-recovery autonomy, mastery, meaning, and affiliation) proposed by Newman, Tay, and Dinner (Newman et al., 2014), discussed in Chapters III and V, also can explain our thesis. According to this theory, explained by a quantitative summary of theories from 363 research articles linking leisure and SWB, both structural and subjective leisure relates to SWB via psychological mechanisms (cited above) by promoting the domain of leisure as one of many domains affecting global SWB.

Additionally, looking at what keeps people away from well-being, a recent systematic review (Nguyen Ho et al., 2023) showed that self-esteem, self-concept, and self-efficacy were the only consistent paths explaining PA influence on psychiatric symptoms (e.g., anxiety and depression) across the lifespan, and the data that indicated these relations were from a specific type of PA, the physical exercise. Physical exercise is a subcategory of PA that is planned, structured, repetitive, and performed to improve or maintain one or more components of physical fitness (Caspersen et al., 1985). This type of PA is not performed during domestic tasks or commuting but with time dedication, regularity, and free time to dislocate from other daily life activities (i.e., during a subtype of leisure-time – free time).

Another relevant point is that, when it comes to PA to improve well-being, HRQoL, or even general health, the studies indicate that PA must be regular and maintained as a habit to show results. The studies about adherence (and maintenance) of PA have gained increasing attention in the past years because of the high levels of physical inactivity and the high dropout rates from health clubs (i.e., one of the most popular settings for supervised exercise practice) (Sperandei et al., 2016). A robust research field indicates that enjoyment and pleasure are relevant factors that can explain and support exercise behavior and are relevant predictors of the intention to continue exercising (Teixeira et al., 2021, 2022). Thus, it is also plausible to admit that LTPA is the only form of PA that could lead (compared to IPA) to enjoyment, making PA habitual and part of the leisure-time (specifically free time). Finally, IPA may have low intensity, which is not enough to improve cardiorespiratory capacity or discharge only for brief moments. It could also maintain heart rate and high blood pressure for several hours during the shift/working period, maintain the isometric contraction of postural muscles in the handling of objects or loads, not have the proper recovery time, and still generate increased levels of inflammation and pain (Holtermann et al., 2012; Holtermann, Krause, van der Beek, et al., 2018), which in term have even been associated with mental health issues (Archer et al., 2014), reinforcing our thesis that LTPA is more beneficial to health.

The problem is that modern society has been experiencing “time poverty”, i.e., the chronic feeling of having too many things to do and not enough time to do them (Giurge et al., 2020; Goodin et al., 2005), a paradox, since that in the past decades, the working hours have declined after the industrial revolution (Giattino et al., 2024) indicating that people have more leisure-time but, do not feel that as free time. Among white-collar workers (i.e., typically work in an office setting, performing administrative or managerial tasks), one of the reasons why free time is not perceived can be the lack of barrier between work and leisure-time reported in the past years, mainly after COVID-19 pandemic (Mascarenhas et al., 2021). Beyond the increase in the workhours at home in several urban centers (McDermott & Hansen, 2021), due to mobile communication technologies, employees answering emails or text messages, send reports, and feel "be always on" during nonworking hours, what can be called of “extended work availability” (Bergman & Gardiner, 2007). This invasion by work in the leisure-time has been associated with daily start-of-day mood and cortisol awakening response harmed (Dettmers et al., 2016) and with increase in emotional exhaustion, mediated by work-to-family conflict and the lack psychological detachment (Dettmers, 2017). However, even before the massive use of technologies, social theories already warned how modern capitalism and neoliberalism, characterized by flexibility of contracts, schedules, competitiveness, informality, employment instability, unprotect and poorly paid – nowadays called precariousness work (M. R. M. de Araújo & Morais, 2017), could cause social disintegration through the retraction of the social world, free time to potential development and family (G. P. D. Araújo & Ouriques, 2009). In fact, a study conducted in Europe tested a model to find whether and how neoliberal ideology might affect individuals' well-being and indicated that the perceived neoliberalism reduced well-being by increasing a sense of competition and lack of connection between people through the mediation of loneliness (Becker et al., 2021). This social detachment ratifies the idea that in the current model of society, work dominates people's lives, takes them away from leisure-time and social connection, and reduces their individual and collective well-being, despite their suggestions to the contrary (Becker et al., 2021; Card & Hepburn, 2023).

Another factor is that individuals in lower socioeconomic positions often need to work more than one job to supplement their income and cannot delegate household tasks to third parties, thus using their leisure-time to accomplish them. Thus, it is plausible that people do not feel their free time and cannot dedicate to LTPA, ratifying the numerous studies that report the “lack of time” is one of the most critical barriers to LTPA practice (Cerin et al., 2010; Koh et al., 2022; Rech et al., 2018; Souza et al., 2022).

On the other hand, blue collars-workers (i.e., workers who perform manual labor, work at factory jobs, or do any other type of labor that does not involve working in an office) who can have the workhours more defined (without contact with employers during the nonworking hours), the leisure-time can be seen as recovery, sitting or lying, i.e., without PA, or at least for men. For example, in a cross-sectional study with data from 895 blue-collar workers in low socioeconomic positions who wore accelerometers for 1‒5 consecutive workdays, men spent more waking leisure-time sedentary than women ($p<0.001$). The authors suggested that women performed more household tasks (OPA) during their leisure-time (Rasmussen et al., 2018) than men, driven mainly by leisure-time standing, indicating gender differences in distribution of leisure-time, mainly in the free time. In Chapter V, we could find a sample of this difference since the women considered active in IPA had +60 min/week of PA compared to men active in IPA. Since people considered active in IPA in our study reported not performing structured PA, this difference can probably be explained by women’s participation in activities related to home and family care or commuting.

Although daily occupation-related energy expenditure has decreased in the past decades (Church et al., 2011) due to a shift away from occupations that require moderate intensity PA to occupations that are largely composed of sitting and sedentary behavior, blue collar-workers need to recover after a workday (Veldhoven, 2008). However, leisure-time SB and OPA, as seen in this thesis, are the main behaviors negatively associated with SWB, QoL, and mental health, driving them (men and women) at risk. Nevertheless, inequalities in leisure-time distribution have been identified over the years and in diverse places. For example, studies from OCDE about the time-use indicate that people in the wealthiest countries work fewer hours per day and dedicate more time to leisure activities than other countries (for example, people in Portugal and Mexico spend almost half of the time in leisure activities than people in Norway and Ireland) (Ortiz-Ospina et al., 2024). Gender differences in leisure-time also have been identified in the literature. A study with 435 men and 434 women, ranging from 18 to 24 years, showed that men have more leisure-time than women in an European country (Codina & Pestana, 2019). Furthermore, in countries with conservative gender norms, low levels of childcare coverage, limited paternity leave, and lower political power for women, women's leisure quality is lower than men's (Yerkes et al., 2020). Men also report more leisure-time compared to women in all countries of OCDE, with Portugal being one of the most unequal between genders (Ortiz-Ospina et al., 2024).

Regarding LTPA, the literature has also demonstrated that there are inequalities in the distribution of LTPA between gender, socioeconomic positions, and race/ethnicity (Gidlow et al., 2006; Mielke et al., 2021; Sayed et al., 2023), that is, women, black people, those with lowest education level, immigrants, and elderlies are the less active in the leisure-time (Gidlow et al., 2006; Mielke et al., 2021; Sayed et al., 2023; Wendt et al., 2023) becoming these groups more susceptible to chronic disease and less LS, like observed in the current thesis (e.g., chapter IV).

Regarding SB, we can conclude that although it has already been recognized as a harmful behavior for well-being and QoL, the context also matters. Younger adults (the most part of our sample) who recently emerged from adolescence spend most of their free time in front of screens on social media (passive leisure-time) (NW et al., 2021), as detailed in Chapter VI, and our data indicated that leisure-time SB seems more harmful to PWB. In contrast, other domains were not associated with other psychological outcomes in younger adults. Like other studies, our sample of students (average age 25 years old [±8] spend more than 2 daily and almost 4 hours sitting during their leisure-time in front of screens depending on the day (173 min/day [± 131] on weekdays and 230 min/day [±154] on weekend. This exposure puts them at the risk of reducing their psychological well-being, which is corroborated by other studies that indicate that > 2 hours/day on screen time harm several well-being measures (Sui, et al., 2021).

We argue that in addition to being exposed to the negative effects of SB "per se", younger adults are more exposed to various types of content, potentially criminals (such as cyberbullying, cyber-dating violence, sextortion, sexting, revenge porn, online dating, catfishing, and scammers) (Paat & Markham, 2021), which can reduce PWB. Another mechanism proposed as a reducer of well-being in younger people who use social media is upward social comparison (i.e., comparisons to those they believe are better than them in some way). This type of comparison could reinforce the users' impression of others being happier, more popular, and prettier or having cooler stuff or a better life, leading to reduction of self-esteem and positive affect in adolescents and younger adults (Irmer & Schmiedek, 2023; Vogel et al., 2014; J.-L. Wang et al., 2017). Furthermore, a recent systematic review reported that the use of smartphones and other forms of media by young people is widespread, leading to chronic sleep deprivation, negatively impacting their cognitive abilities, school performance, and socio-emotional well-being (Khalaf et al., 2023). Finally, this free time in front of the screens competes with other physical activities that would positively impact psychological measures, for example, self-acceptance, positive relations with others and purpose in life (Rodríguez-Bravo et al., 2020), changing this tendency.

Additionally, our research demonstrated that for adults (≥ 25 years), occupational SB was negatively associated with GLS and MCS, and transport-related SB was negatively associated with PWB. In contrast to what happened in the younger group, leisure-time SB was not associated with well-being outcomes. As mentioned in Chapters III and VI, sitting at work, long hours under work stress, and the time spent commuting (usually by car or in public transportation) can reduce the well-being and QoL in adults with sedentary work, since our day hours are a limited resource and these hours (work hours + commuting) reduce our free time, making it difficult our dedication to LTPA.

To further confirm the hypothesis generated in the observational investigations, we performed an experimental study with 38 university employees. We aimed to test whether the ST reduction in the occupational domain by a sit-stand-desk use for six months versus a control group could impact the well-being and QoL. After the intervention period, we could observe (as seen in Chapter VII) that no significant time*group interaction was found for the primary outcome (ST), which impaired our analysis of the impact of ST reduction in the SWB and QoL. However, when looking at the raw data, we found reductions in ST in some participants from both groups, indicating that sit-stand-desk use barely influence ST, but the previous psychoeducational session regarding the benefits of reducing ST and their risks could have influenced the participants from both groups. Thus, after an additional exploration of the results, we found that both ST reducers and non-reducers improved significantly their QoL scores compared to baseline, but the reducers improved more than the non-reducers, although without time*group interaction. However, only those who reduced ST significantly improved SWB with a larger statistical power, although also without time*group interaction. The reasons why there may not have been differences in the QoL and SWB between groups are discussed in Chapter VII, and we believe that may have been the time of the intervention (6 months), which may not have been able to capture the changes that the reduction of ST could cause on both. In addition, our total sample consisted of people with reasonably high QoL score values, leaving little margin for improvement. Thus, we argue that ST in the occupational domain can negatively impact two of the most important well-being indicators, SBW and QoL. However, future longitudinal investigations are needed to confirm these results on a larger scale and determine whether ST reduction, specifically in the workplace (not ST in the 24 hours), could affect well-being and QoL.

Finally, these findings and the general conclusions raise questions about whether the time dedicated to work in modern society, with the technology that invades our lives and keeps us sitting most of the time, is sustainable regarding mental health. Besides that, what are we doing to reduce the inequality in leisure-time among genders, and how do our young people spend their free time? Considering that systemic changes and not just individual behavior must happen to improve PA levels and reduce inequalities, we argue that it is urgent to allow adults to have more free time (subjectively perceived and not related to unpaid activities or other responsibilities) to dedicate themselves to LTPA and other pleasurable activities; in addition, the gender disparity and of socioeconomic status in the distribution of leisure-time must be alleviated by public interventions, through new laws on working hours for women, reduction of income inequalities and more access to PA for minority groups. Recent studies corroborate this argument and indicate that a reduction of 4.8% in inactivity levels among women across the world would achieve the WHO target of reducing global levels of inactivity by 10% (Mielke et al., 2018) and that if there were no income inequality, the insufficient PA would be 12 to 15% (today is 27.5% stable over the past ten years), in high and middle-income countries and the gender activity gap would disappear (Sfm et al., 2020).

Furthermore, we have seen that LTPA indirectly can contribute to other healthy behaviors, as greater adherence to the Mediterranean diet, it was positively associated with the physical component of HRQoL, which, in turn, is negatively associated with mental disorders (Comer et al., 2011), besides that, LTPA also allowed that participants had less leisure-time SB, which are indirect benefits of leisure-time.

1.3. Future directions

Finally, according to the results, improving well-being implies going beyond the standard recommendations of the main health entities for the practice of PA and reducing SB; Context matters! PA should be prioritized in the leisure context and people must target a reduction of SB in the occupational context. The strategies for both could be based on the already known 4-day working week (or reduction of working hours) implemented by several countries as a pilot study (*Countries with a 4 Day Work Week*, 2024). In addition to benefits such as reduced costs, fewer health problems, and increased productivity levels, early research has indicated that employees report lower stress levels, improved sleep habits, and better working-life quality (Voglino et al., 2022). We can argue that with more leisure-time, people can choose more active ways to spend their free time, but more intervention research must be conducted, since the opposite can also occur (i.e., more leisure-time SB) depending on the type of work and socioeconomic status or more IPA, depending on gender. Furthermore, to sedentary workers, less time at work means less ST; thus, it will be possible to confirm the impact that total ST reduction can have on psychological measures in the medium to long term.

Taking into account that 27.5% of adults (Guthold et al., 2018) and 81% of adolescents (Guthold et al., 2020) currently do not meet PA recommendations and spend most of their leisure-time in front of screens (Carpenter et al., 2021) (as seen in Chapter VI) on social media or watching TV, we believe that is necessary a joint action by policies makers and society to mitigate the negative effects that the use of social media have mainly among adolescents. Some entities like the American Psychological Association have a set of ongoing discussions about social media that can help parents protect teens' brain development (American Psychological Association, 2023), including time limits, parental monitoring, and supervision. Concerning PA levels, WHO has developed a global action plan to help countries scale up policy actions to promote PA. The plan sets out four objectives and recommends 20 policy actions that are applicable to all countries and address the cultural, environmental, and individual determinants of inactivity (*Let's Be Active, the Global Action Plan on Physical Activity 2018 - 2030*, 2018) and we hope that the countries follow this plan to mitigate the impact of physical inactivity on chronic diseases and on well-being and QoL. A vital feature of this global plan is its call for a "systems-based" approach where effective implementation will require bold leadership combined with cross-government and multisectoral partnerships at all levels to achieve a coordinated, whole-of-system response.

Recent research has also introduced the idea of "exercise snacks" to improve PA levels, since the high levels of inactivity in recent years. Exercise snacks are an emerging concept in sports science, which aims to re-evaluate the conventional emphasis on accumulating a PA weekly of 150 min. Instead, exercise snacks concentrate on frequent yet shorter-durations exercise sessions throughout the day, such as 1-min stair climbing or 20-second (s) sprints (Islam et al., 2022). Their results have demonstrated that regardless of the duration, every engagement in PA can positively impact overall physical health and improve cardiovascular fitness, metabolic capacity, and muscular function, mainly for inactive people. This improvement would be mainly through physiological mechanisms (i.e., activation of classic intracellular signaling pathways, such as AMPK, and transcriptional regulator factors, such as peroxisome proliferator-activated receptor gamma coactivator 1-alpha) (T. Wang et al., 2024).

However, this proposes boosting the people's exercise in any context such as at work or home, and more research is necessary to verify its effectiveness for well-being and QoL of this type of exercise in any domain.

Finally, we argue that, for people to have more free time, public policies need to promote social inclusion and economic growth, ensuring equal opportunities between genders (United Nations, 2015) and reducing inequalities of income with a reduction of the precariousness of work and reduction of workhours as cited above. Although we want to believe that just lifestyle and environmental factors (such as smoking, PA, and more cycle paths) are the most important determinants of health, recent research suggests that social factors (such as loneliness and social isolation, some of the consequences of the current neoliberalism) have the same or even a greater impact on health (Holt-Lunstad et al., 2015). Moreover, leaving the responsibility for achieving the desired well-being and QoL as an individual responsibility rather than as the responsibility of the whole of society, seems cruel given the radical changes caused by neoliberalism in society in recent decades. Thus, we finish this thesis agreeing with Diener & Seligman (2004) when claim that: the search for well-being will be harmed as long as people do not have enough money to satisfy their basic needs and fulfill their main goals.

1.4. Strengths and limitations

One of the main limitations of the present investigation is that, although we included one longitudinal study, the majority of the studies were observational (including 77% of the systematic review) and, therefore, did not allow us to establish causality. Besides that, it was not possible to utilize more appropriate questionnaires in our research (for example, the Global Physical Activity Questionnaire [GPAQ]) that, besides evaluating the amount of PA, also assesses three domains of PA). However, we resolved this issue with an appropriate question about the physical exercise practice in Chapters IV and V. Besides that, we must highlight that questionnaire-based measures are prone to measurement error, and participants in our study may have overreported their levels of PA, as well as underreported periods of SB, which has been attributed to social desirability and non-recall of some types of PA (Adams et al., 2005).

Interestingly, in Chapter IV, other common health measures such as sleep, chronic diseases, diet, or meeting the recommended PA guidelines were not associated with LS. This suggests that in an academic setting where most individuals are young adults with an average age of 35, these factors may be less crucial since individuals are relatively healthy. For instance, only 18% of the participants reported having a chronic disease. Besides that, Chapter V psychological measures (psychological well-being [PWB], mental component SF-12 [MCS-

12]) did not present significative differences between being active in LTPA or IPA, indicating a possible ceiling effect since our sample had reasonably good scores in PWB and MCS-12. Besides that, the more significant effects of the PA look like be better in people with mental disorders (Posadzki et al., 2020), what did not the case in our sample.

Finally, on chapter V, we analyzed the differences between sexes at birth and not by gender (i.e., socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time), which cannot be applicable when people do not identify themselves with their sex at birth. However, we believe that this is not a significant issue since only 1% (N=4) preferred not to declare their sex when filling out the questionnaire.

The major strength of the systematic review pertains to the inclusion of SB and not only PA domains. To the authors' knowledge, no systematic review encompassed several domains of PA and SB, thus representing novelty to this research field. Another strengths of this study are the diversity of variables assessed and the innovative approach to the exploration of the domains of PA and SB, which is in line with recent recommendations (Quinn & Gibbs, 2023). We consider this information of particular importance, given that a Cochrane review (Posadzki et al., 2020) on the efficacy of PA in 54 different health conditions (e.g., mortality, cancer, physical and cognitive decline, glycemic control) indicated that the magnitude and effect size were higher among patients with mental health conditions. Therefore, it would be of critical importance that health systems throughout the globe (especially those related to mental health) not only actively refer patients to the practice of regular PA but also specify the domain where the evidence is stronger (i.e., LTPA). Besides that, our data and others alike can contribute to the creation of more precise PA recommendations that can attend to the needs of the entire population (i.e., different sections of the population), avoiding the message that people who can only meet the minimum recommended amount in non-leisure domains will obtain the same benefits as those who performed PA in leisure-time, lowering perpetuated health inequalities.

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Chapter VIII

Bibliography

Qualquer um que saiba alguma coisa da história sabe que grandes mudanças sociais são impossíveis sem o fermento feminino.

Karl Marx

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Annexes

Annexes I: Questionnaire applied to participants within the scope of the LusófonAtiva study that comprises studies 2, 3 and 4.

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LUSÓFONAtiva

Gostaríamos de o convidar a participar num estudo científico que pretende conhecer melhor os **comportamentos de saúde ligados à atividade física, alimentação e bem-estar, e o que os pode influenciar, na comunidade da Universidade Lusófona de Humanidades e Tecnologias (ULHT) - Lisboa**. Tal permitirá não só o avanço do conhecimento, através do estabelecimento de um sistema de monitorização epidemiológica dos comportamentos referidos, mas também o desenvolvimento de melhores práticas de promoção da saúde neste contexto.

Este estudo foi aprovado pela Comissão de Ética da Faculdade de Educação Física e Desporto, e realizado pelos centros de investigação CIDEFES (da Faculdade de Educação Física e Desporto) e CICANT (da Escola de Comunicação, Arquitetura, Artes e Tecnologias da Informação), da ULHT.

Se tem 18 ou mais anos de idade e <u>se está a frequentar o ensino superior na ULHT (licenciatura, mestrado ou doutoramento)</u>, agradecemos o seu contributo através do preenchimento online de um conjunto de questões.

As suas respostas serão codificadas cumprindo a legislação aplicável em matéria de proteção de dados: **os dados recolhidos são anónimos, confidenciais, protegidos de forma segura e acessíveis apenas à equipa de investigação**. As respostas serão analisadas de forma agrupada, e nunca de forma individual.

A sua participação é voluntária. Caso decida participar neste estudo pode, ainda assim, desistir a qualquer momento.

Agradecemos desde já a sua colaboração, a sua opinião e experiência é muito importante!

Declaro que li e...

○ ACEITO as condições da minha participação

○ NÃO ACEITO as condições da minha participação

Qual é a sua idade, em anos?

▼ 18 ... 80

Qual é a sua altura, <u>em metros</u>?
- Utilize o ponto como separador decimal, por exemplo 1.72 -

____

Qual é o seu peso atual, <u>em kilogramas</u>?
- Utilize o ponto como separador decimal, por exemplo 70.5 -

____

Sexo com que nasceu

○ Masculino

○ Feminino

○ Outro / Prefiro não dizer

Grau Académico que se encontra a frequentar (no caso de professores e funcionários, esta pergunta foi alterada).

○ Licenciatura. Em que ano? ______________________________

○ Mestrado

○ Doutoramento

Área do Grau Académico que se encontra a frequentar (no caso de professores e funcionários, esta pergunta foi alterada)

○ Ciências da Saúde

○ Ciências Naturais

○ Ciências Sociais

○ Literaturas e Artes

○ Engenharias

○ Desporto

○ Outra: ____

Qual foi a média do último semestre letivo frequentado? (1 a 20 valores)

▼ 1 ... 20

Alguma vez reprovou de ano?

- ◯ Não
- ◯ Sim. Quantas vezes? ______________________________

Com quem vive atualmente (durante o período letivo)?

- ◯ Sozinho
- ◯ Com família
- ◯ Casa partilhada com outras pessoas. Quantas? ______________________________

Qual é a opção que melhor representa a sua situação atual?

- ◯ Profissionalmente ativo/a (dependente ou independente) (Full time)
- ◯ Profissionalmente ativo/a (dependente ou independente) (Part time)
- ◯ Estudante a tempo inteiro (não trabalhador)
- ◯ Outra (bolsa, estágio, etc.)

Como classifica a sua situação financeira atual?

- ◯ Muito confortável
- ◯ Confortável
- ◯ Suficiente para as necessidades
- ◯ Difícil
- ◯ Muito difícil

Qual a sua forma mais habitual de se deslocar entre lugares (p.ex. entre casa e a universidade)?

- ○ A pé ou de bicicleta (não elétrica)
- ○ Bicicleta ou trotinete (elétrica)
- ○ Transportes públicos
- ○ Carro ou mota

Indique o seu grau de concordância com as afirmações seguintes:

A Universidade Lusófona preocupa-se em promover comportamentos saudáveis (p.ex. atividade física e alimentação).

- ○ Discordo totalmente
- ○ Discordo parcialmente
- ○ Não concordo nem discordo
- ○ Concordo parcialmente
- ○ Concordo totalmente

O ambiente do campus da Universidade Lusófona e os locais em redor deste (Campo Grande) oferecem um ambiente aprazível e opções para se ser fisicamente ativo (p.ex. caminhar, correr, andar de bicicleta, praticar desporto).

- ○ Discordo totalmente
- ○ Discordo parcialmente
- ○ Não concordo nem discordo
- ○ Concordo parcialmente
- ○ Concordo totalmente

Existe boa oferta alimentar (opções saudáveis) dentro do campus da Universidade Lusófona.

- ◯ Discordo totalmente
- ◯ Discordo parcialmente
- ◯ Não concordo nem discordo
- ◯ Concordo parcialmente
- ◯ Concordo totalmente

Estamos interessados em conhecer os seus níveis habituais de atividade física.

As perguntas referem-se ao **tempo que passa em atividade física numa semana**, incluindo atividades que faz no seu dia-a-dia, para se deslocar de um lado para outro, atividades que pode fazer em casa ou no jardim e atividades que efetua nos seus tempos livres para se distrair, fazer exercício ou desporto. Todos os minutos contam, por isso, por favor responda a todas as perguntas mesmo que não se considere uma pessoa ativa.

Ao responder considere o seguinte:

Atividade física vigorosa *refere-se a atividades que requerem muito esforço físico e tornam a respiração muito mais intensa que o normal* (i.e. não se consegue falar nem cantar).

Atividade física moderada *refere-se a atividades que requerem esforço físico moderado e tornam a respiração um pouco mais intensa que o normal* (i.e. consegue-se falar mas não cantar).

Habitualmente, **por semana, quantos dias faz atividades físicas vigorosas**, como levantar e/ou transportar objetos pesados, cavar, ginástica aeróbica ou andar de bicicleta a uma velocidade acelerada?

▼ 0 dias por semana ... 7 dias por semana

Nesses dias, quanto tempo costuma fazer atividade física **vigorosa**?
Exemplo: Se faz meia hora por dia coloque 0 horas e 30 minutos; Se faz uma hora e um quarto coloque 1 hora e 15 minutos.
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 55

Habitualmente, por semana, quantos dias faz atividades físicas **moderadas**, como levantar e/ou transportar objetos leves, andar de bicicleta a uma velocidade moderada, subir e descer escadas, aspirar a casa e outras atividades de esforço moderado? Não inclua o andar a pé / caminhar.

▼ 0 dias por semana ... 7 dias por semana

Nesses dias, quanto tempo costuma fazer atividade física **moderada**?
Exemplo: Se faz meia hora por dia coloque 0 horas e 30 minutos; Se faz uma hora e um quarto coloque 1 hora e 15 minutos.
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 55

Habitualmente, por semana, quantos dias **anda a pé/caminha**? Inclua caminhadas para se deslocar de um lado para outro e qualquer outra caminhada que possa fazer somente para recreação, desporto ou lazer.

▼ 0 dias por semana ... 7 dias por semana

Nesses dias, quanto tempo costuma **caminhar**?
Exemplo: Se faz meia hora por dia coloque 0 horas e 30 minutos; Se faz uma hora e um quarto coloque 1 hora e 15 minutos.
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 55

Costuma praticar atividade física estruturada (p.ex., corrida, caminhada, exercício no ginásio, dança ou atividades desportivas)?

◯ SIM, costumo praticar atividade física estruturada

◯ NÃO, não costumo praticar atividade física estruturada

Que tipos de atividade física programada costuma praticar?

	Sim	Não
Corrida	○	○
Caminhada	○	○
Treino de força	○	○
Dança	○	○
Atividades de fitness (aulas de grupo, etc.)	○	○
Bicicleta	○	○
Desportos individuais (quais?)	○	○
Desportos Coletivos (quais?)	○	○
Outra/s (quais?)	○	○

Indique quão frequentemente, <u>no último mês</u>...

	Nunca	Poucas vezes	Algumas vezes	Muitas vezes	Sempre que possível
Subiu escadas em vez de utilizar elevadores ou escadas rolantes (p.ex. no seu prédio, em centros comerciais, no local de trabalho, etc.)	○	○	○	○	○
Escolheu estar em pé em situações em que podia estar sentado (p.ex. enquanto fala ao telefone, enquanto espera em locais públicos ou pelo transporte, etc.)	○	○	○	○	○

As próximas questões referem-se ao tempo que passa sentado(a) / reclinado(a) / deitado(a), diariamente, na faculdade, em casa, no trabalho, nos transportes ou outros contextos e durante os tempos livres **(não inclua o tempo que passa a dormir)**.

Quanto tempo esteve sentado/a num dia típico de semana?
Exemplo: 6 horas e 45 minutos.
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 55

Quanto tempo esteve sentado/a num dia típico de fim de semana?
Exemplo: 6 horas e 45 minutos.
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 55

Por dia, em média, quanto tempo costuma estar...

	Hora(s), dia de semana	Minuto(s), fim de semana	Hora(s), fim de semana	Minuto(s), dia de semana
Sentado(a) a trabalhar, em aulas, ou a estudar com ecrã	▼ 0 ... 24	▼ 0 ... 55	▼ 0 ... 24	▼ 0 ... 55
Sentado(a) a trabalhar, em aulas ou a estudar sem ecrã	▼ 0 ... 24	▼ 0 ... 55	▼ 0 ... 24	▼ 0 ... 55
Sentado(a) a ver televisão/computador/tablet/telemóvel, por lazer	▼ 0 ... 24	▼ 0 ... 55	▼ 0 ... 24	▼ 0 ... 55
Sentado(a) em transportes (próprio ou público)	▼ 0 ... 24	▼ 0 ... 55	▼ 0 ... 24	▼ 0 ... 55
Sentado(a) a realizar um hobbie (tocar instrumento musical, jogar cartas, palavras-cruzadas, ler, etc)	▼ 0 ... 24	▼ 0 ... 55	▼ 0 ... 24	▼ 0 ... 55

Habitualmente, quando está sentado, quão frequentemente se costuma levantar?

- ◯ Estou mais de 3 horas sem me levantar
- ◯ Estou mais de 1 hora sem me levantar
- ◯ Levanto-me de hora em hora
- ◯ Levanto-me, pelo menos de meia em meia hora

x

É possível ter a indicação de alguns indicadores de saúde quer no **telemóvel** quer através de outros dispositivos (*smartwatches*, por exemplo). Procure indicar, com base na visualização desses aparelhos:

Número médio diário de passos
(se não utiliza essa funcionalidade, preencha com um x)

____

Este valor foi calculado com base nos(as) últimos(as)...

- ○ Dias
- ○ Semanas
- ○ Meses
- ○ Anos
- ○ Não utilizo esta funcionalidade

Tempo médio diário de ecrã (no caso do telemóvel). *Exemplo: 4 horas 20 minutos por dia.*
(se não utiliza essa funcionalidade, preencha com um x)
Hora(s)
Minuto(s)

▼ X ... 24 ~ 55

Este valor foi calculado com base nos(as) últimos(as)...

- ○ Dias
- ○ Semanas
- ○ Meses
- ○ Anos
- ○ Não utilizo esta funcionalidade

Numa semana típica...

A que horas se deita à noite, na maioria das vezes?
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 45

A que horas acorda de manhã, na maioria das vezes?
Hora(s)
Minuto(s)

▼ 0 ... 24 ~ 45

Numa semana típica...

	Nunca	Menos de 1x por semana	1 ou 2x por semana	3x por semana ou mais
Tem problemas para dormir?	○	○	○	○
Tem problemas em ficar acordado(a) durante as refeições, aulas, enquanto conduz ou participa nalguma atividade social?	○	○	○	○

Frequentou aulas de **Educação Física** na escola?

○ Sim

○ Não

Qual a sua opinião relativamente às **aulas de Educação Física**?

	Nada	Pouco	Mais ou menos	Muito	Muitíssimo
Gostava das aulas	○	○	○	○	○
Considerava as aulas importantes para a minha formação	○	○	○	○	○
Considerava-me um(a) bom(a) executante nas várias atividades das aulas	○	○	○	○	○

Relativamente a **atividades desportivas**...

Fez parte de atividades desportivas organizadas (ex: escola, clubes, etc)?

- ○ Nunca
- ○ Menos de 1x por semana
- ○ 1x a 2x por semana
- ○ Quase todos os dias

Quantas atividades desportivas praticou em simultâneo:

- ○ Nenhuma (só fazia 1 atividade)
- ○ 2 atividades
- ○ 3 atividades
- ○ Mais de 3 atividades

Participava em competições desportivas? (selecione todas as opções que se aplicam)

- ☐ Nenhum
- ☐ Interescolar
- ☐ Clube federado
- ☐ Nível nacional
- ☐ Nível internacional

Como se **costuma sentir** habitualmente quando pratica atividade física? Escolha numa escala de -5 a 5.

- ○ -5 (Muito mal)
- ○ -4
- ○ -3 (Mal)
- ○ -2
- ○ -1
- ○ 0 (Neutro)
- ○ 1
- ○ 2
- ○ 3 (Bem)
- ○ 4
- ○ 5 (Muito bem)

Considere as **razões pelas quais faz/faria atividade física** e indique, em cada afirmação, o seu grau de concordância com a mesma.

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
Sinto-me culpado(a) quando não faço exercício	○	○	○	○	○
Dou valor aos benefícios/vantagens do exercício	○	○	○	○	○
Penso que fazer exercício é uma perda de tempo	○	○	○	○	○
Faço exercício porque outras pessoas me dizem para o fazer	○	○	○	○	○
Faço exercício porque sinto orgulho de mim próprio/a quando consigo persistir	○	○	○	○	○
Considero que fazer exercício é uma parte fundamental daquilo que eu sou	○	○	○	○	○
Gosto das minhas sessões de exercício	○	○	○	○	○

Considere **como se sente quando pratica atividade física** e indique, em cada afirmação, o seu grau de concordância com a mesma.

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
Tenho uma sensação de escolha e liberdade	○	○	○	○	○
Sinto-me capaz naquilo que faço	○	○	○	○	○
Experiencio um sentimento caloroso com as pessoas com as quais me relaciono	○	○	○	○	○
Sinto que o faço por “obrigação”	○	○	○	○	○
Na maioria das vezes, sinto-me desapontado com o meu desempenho	○	○	○	○	○
Sinto-me excluído do grupo ao qual eu quero pertencer	○	○	○	○	○

No geral, em relação à **atividade física**...

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
Sou muito confiante acerca do meu nível de condição física e fitness quando comparado com outras pessoas					
Faço muito bem todos os tipos de desportos					
Tenho tendência para ter sentimentos negativos acerca da minha habilidade em atividades desportivas					
Estou à vontade nos locais onde se faz exercício					
Sinto-me muito confiante nas minhas capacidades para manter exercício regular e condição física					
Para mim, fazer atividade física é tão importante como outras coisas que valorizo na minha vida					
Faço atividade física porque quero, não porque sinta que tenho de o fazer					
Consigo integrar a prática de atividade física no meu dia-a-dia					
No meu dia-a-dia, existem espaços, situações ou pessoas que me incitam a mexer-me mais					
Na zona onde moro e/ou trabalho, vejo frequentemente outras pessoas a andar pé ou a fazer outras atividades físicas					

Indique em que medida, de 1 a 5, estes **objetivos para a prática de exercício** são importantes para si.

	Nada importante	Pouco importante	Moderadamente importante	Importante	Extremamente importante
Para me relacionar com os outros	○	○	○	○	○
Para melhorar a aparência geral do meu corpo	○	○	○	○	○
Para aumentar a minha resistência às doenças	○	○	○	○	○
Para que os outros tenham uma boa impressão de mim	○	○	○	○	○
Para adquirir novas competências ao nível da prática de exercício físico	○	○	○	○	○

Indique, em cada afirmação, o seu grau de concordância com a mesma.

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
A inatividade física é tão prejudicial para a saúde como o consumo de tabaco e de álcool em excesso	○	○	○	○	○
Subir escadas ou estar mais tempo em pé não é fazer atividade física	○	○	○	○	○
A atividade física tem que ter grande intensidade para ter efeitos benéficos	○	○	○	○	○

Nas questões seguintes marque aquela que lhe parecer ser a resposta adequada:

Quanto tempo de atividade física **moderada** (ex. marcha rápida ou corrida leve) **deve uma pessoa adulta acumular, no mínimo, numa semana, de acordo com a Organização Mundial de Saúde?**

○ 60 minutos

○ 90 minutos

○ 150 minutos

○ 300 minutos

Aptidão cardiorrespiratória significa?

○ O quão bem os músculos conseguem empurrar, puxar ou alongar

○ O quão bem o coração consegue bombear sangue e quão bem os pulmões conseguem fornecer oxigénio

○ Ter um peso saudável para a sua altura

○ A nossa habilidade para praticar desportos que gostamos

Força muscular ou resistência muscular significa?

○ O quão bem os músculos conseguem empurrar, puxar ou alongar

○ O quão bem o coração consegue bombear sangue e quão bem os pulmões conseguem fornecer oxigénio

○ Ter um peso saudável para a sua altura

○ A nossa habilidade para praticar desportos que gostamos

É vegetariano (ovolactovegetariano, lactovegetariano, ovovegetariano, ou vegetariano estrito/vegano)?

○ Sim

○ Não

Com que frequência consome:

Cereais não refinados (pão integral/de mistura, massa e arroz integral, etc.)
1 porção equivale a 1 fatia de pão/1 bola, ½ chávena de arroz ou massa.

- ◯ Nunca
- ◯ 1-6 porções regulares por semana
- ◯ 7-12 porções regulares por semana
- ◯ 13-18 porções regulares por semana
- ◯ 19-31 porções regulares por semana
- ◯ ≥32 porções regulares por semana

Batatas
1 porção equivale a ½ chávena de batata cozida/puré, 1 chávena de batatas fritas, 1.5 batatas cruas.

- ◯ Nunca
- ◯ 1-2 porções regulares por semana
- ◯ 3 porções regulares por semana
- ◯ 4 porções regulares por semana
- ◯ ≥5 porções regulares por semana

Fruta
1 porção equivale a 1 peça de fruta média - p.ex., 1 maçã/laranja, 1 banana pequena, 1 fatia de melancia/melão, 10-12 cerejas/morangos/uvas.

- ◯ Nunca
- ◯ 1-4 porções regulares por semana
- ◯ 5-8 porções regulares por semana
- ◯ 9-15 porções regulares por semana
- ◯ 16-21 porções regulares por semana
- ◯ ≥22 porções regulares por semana

Hortícolas (crus ou cozinhados)

1 porção equivale a 1 chávena grande de hortícolas crus - p.ex., salada de alface e tomate - ou a ½ chávena cozinhados - p.ex., bróculos cozidos, mistura de legumes salteados.

- Nunca
- 1-6 porções regulares por semana
- 7-12 porções regulares por semana
- 13-20 porções regulares por semana
- 21-32 porções regulares por semana
- ≥33 porções regulares por semana

Leguminosas (grão, feijão, ervilhas, etc.)

1 porção equivale a 1 chávena.

- Nunca
- 1-2 porções regulares por semana
- 3-4 porções regulares por semana
- 5-6 porções regulares por semana
- ≥7 porções regulares por semana

Peixe (e derivados do mar)

1 porção equivale a 120g de peixe cozinhado - p.ex., 1 posta do tamanho da mão.

- Nunca
- 1-2 porções regulares por semana
- 3-4 porções regulares por semana
- 5-6 porções regulares por semana
- ≥7 porções regulares por semana

Carnes vermelhas e produtos de charcutaria

1 porção equivale a 120g de carne cozinhada – p.ex., 1 bife do tamanho da mão; se nunca consome carne escolha a opção ≤1.

- ◯ ≤1 porções regulares por semana
- ◯ 2-3 porções regulares por semana
- ◯ 4-5 porções regulares por semana
- ◯ 6-7 porções regulares por semana
- ◯ 8-10 porções regulares por semana
- ◯ ≥11 porções regulares por semana

Carnes brancas (de aves)

1 porção equivale a 120g de carne cozinhada - p.ex., 1 bife do tamanho da mão; se nunca consome carne escolha a opção ≤3.

- ◯ ≤3 porções regulares por semana
- ◯ 4 porções regulares por semana
- ◯ 5-6 porções regulares por semana
- ◯ 7-8 porções regulares por semana
- ◯ 9-10 porções regulares por semana
- ◯ ≥11 porções regulares por semana

Uso de azeite na confeção

- ◯ Nunca
- ◯ Raramente
- ◯ 1-3 vezes por semana
- ◯ 3-5 vezes por semana
- ◯ Diariamente

Bebidas alcoólicas (1 copo de vinho = 100ml)

○ 0 ml/dia

○ 300 ml/dia

○ 400 ml/dia

○ 500 ml/dia

○ 600 ml/dia

○ ≥700 ml/dia

Toma regularmente algum suplemento alimentar ou nutricional (vitaminas, minerais ou suplementos alimentares)?

○ Sim

○ Não

Indique p.f. os suplementos que tomou:

○ Tipo de suplemento ____

○ Nome comercial ____

○ Quantidade/dia ____

Relativamente ao seu consumo de sal, como o classifica numa escala de 0 (totalmente sem sal) a 100% (muitíssimo salgado)?

0 10 20 30 40 50 60 70 80 90 100

Numa semana típica, quantas vezes...

	Nunca	1-2 vezes	3-5 vezes	6 ou mais vezes
Toma pequeno-almoço?	○	○	○	○
Salta refeições principais (almoço/jantar)?	○	○	○	○
Come refeições caseiras confeccionadas por si/familiares/amigos?	○	○	○	○
Come em restaurantes/bares/cafés ou encomenda comida (take away)?	○	○	○	○
Come refeições rápidas (fast food)?	○	○	○	○

Consegue perceber a informação nutricional presente no rótulo dos alimentos?

○ Sim

○ Não

Alguma vez fumou?

○ Não, nunca fumei

○ Sim, mas não fumo atualmente

○ Sim, fumo atualmente

O que costuma fumar?

○ Cigarros

○ Cigarrilhas

○ Outros. Quais?

Quantos fuma por dia? ___________________________

Para cada afirmação seguinte, indique quão verdadeira/aplicável é para si...

	1 (nada verdadeiro no meu caso)	2	3 (às vezes)	4	5 (totalmente verdadeiro no meu caso)
Dou por mim a comer quando me sinto mais ansioso(a), depressivo(a) ou triste, mesmo que não esteja fisicamente com fome.	○	○	○	○	○
Costumo fazer um esforço consciente para comer menos quantidade do que queria.	○	○	○	○	○
Quando como uma refeição mais calórica, durante um certo período de tempo como menos para compensar.	○	○	○	○	○
A única forma de conseguir controlar o que como é seguir um plano fixo e não me desviar do mesmo.	○	○	○	○	○
Eu confio no meu corpo para me alertar quando devo comer.	○	○	○	○	○
Eu confio no meu corpo para me alertar da quantidade que devo comer.	○	○	○	○	○
Por vezes, quando começo a comer não consigo parar.	○	○	○	○	○
Estar com alguém que está a comer, faz-me querer comer também.	○	○	○	○	○
Quando vejo um prato com aspeto delicioso ou sinto o cheiro de comida apetitosa não resisto a comer, mesmo que tenha acabado há pouco tempo uma refeição.	○	○	○	○	○
Acho que gosto muito mais de comer do que a maioria das outras pessoas.	○	○	○	○	○
Parece que estou sempre a pensar em comida.	○	○	○	○	○

Numa escala de 0 a 10, quão **satisfeito(a)** está com a sua vida, nomeadamente...

	0 (nada)	1	2	3	4	5	6	7	8	9	10 (totalmente)
Com o seu curso	○	○	○	○	○	○	○	○	○	○	○
Com o seu trabalho (se aplicável)	○	○	○	○	○	○	○	○	○	○	○
Com o tempo livre de que dispõe para fazer aquilo de que gosta	○	○	○	○	○	○	○	○	○	○	○
Com as suas relações pessoais (família, amigos, outras pessoas importantes)	○	○	○	○	○	○	○	○	○	○	○
Com a sua vida no geral	○	○	○	○	○	○	○	○	○	○	○

Numa escala de 0 a 10, qual o seu grau de concordância com as seguintes afirmações:

	0 (nada)	1	2	3	4	5	6	7	8	9	10 (totalmente)
Sinto que a minha vida e as coisas que faço valem a pena	○	○	○	○	○	○	○	○	○	○	○
Sinto que a minha vida tem um propósito e direção	○	○	○	○	○	○	○	○	○	○	○

Tem alguma **doença crónica** (física ou psíquica) ou incapacidade diagnosticada por um médico?

○ Não

○ Sim. Qual/quais? ____

Em geral, diria que a sua saúde é:

- ◯ Fraca
- ◯ Razoável
- ◯ Boa
- ◯ Muito boa
- ◯ Excelente

Considera que a sua **saúde atual** o/a limita nas atividades que pode executar no seu dia-a-dia, nomeadamente...

	Nada limitado/a	Sim, um pouco limitado/a	Sim, muito limitado/a
Atividades moderadas, tais como deslocar uma mesa, aspirar a casa, andar de bicicleta ou nadar	◯	◯	◯
Subir vários lanços de escada	◯	◯	◯

Durante o **último mês**, como consequência do seu estado de saúde físico...

	Nunca	Pouco tempo	Algum tempo	A maior parte do tempo	Sempre
Realizou menos trabalho/estudo ou outras atividades diárias do que queria	◯	◯	◯	◯	◯
Sentiu-se limitado/a no tipo de trabalho ou outras atividades	◯	◯	◯	◯	◯

Durante o **último mês**, como consequência do seu estado emocional (tal como sentir-se deprimido/a ou ansioso/a)...

	Nunca	Pouco tempo	Algum tempo	A maior parte do tempo	Sempre
Realizou menos trabalho/estudo ou outras atividades diárias do que queria	◯	◯	◯	◯	◯
Realizou o trabalho ou outras atividades de forma menos cuidadosa que o habitual	◯	◯	◯	◯	◯

Quanto tempo, durante o **último mês**...

	Nunca	Pouco tempo	Algum tempo	A maior parte do tempo	Sempre
Se sentiu calmo/a e tranquilo/a?	○	○	○	○	○
Teve muita energia?	○	○	○	○	○
Sentiu-se triste e deprimido/a?	○	○	○	○	○

Até que ponto, no **último mês**, é que a sua saúde física ou problemas emocionais limitaram a sua atividade social (tal como estar - mesmo de forma digital - com amigos ou familiares próximos)?

- ○ Nunca
- ○ Pouco tempo
- ○ Algum tempo
- ○ A maior parte do tempo
- ○ Sempre

Durante o **último mês**, de que forma é que a dor interferiu com o seu trabalho quotidiano (académico, laboral, doméstico)?

- ○ Nunca
- ○ Pouco tempo
- ○ Algum tempo
- ○ A maior parte do tempo
- ○ Sempre

As afirmações seguintes refletem diferentes **formas de estar** quando temos de **decidir** fazer algo. Responda consoante o seu grau de concordância.

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
Identifico-me fortemente com as coisas que faço	○	○	○	○	○
Faço muitas coisas para evitar sentir-me culpado(a) por não as fazer	○	○	○	○	○
Concordo com certas coisas para que os outros gostem de mim	○	○	○	○	○

Considerando as informações que vê nos **media** (ex.: televisão, revistas, internet, filmes, outdoors e anúncios/propagandas), responda às seguintes afirmações consoante o seu grau de concordância.

	Discordo totalmente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo totalmente
Fazendo dieta ou exercício, a maior parte das pessoas poderia ter corpos tão atrativos como os dos modelos que aparecem nos anúncios/média	○	○	○	○	○
Sinto pressão dos média para melhorar minha aparência	○	○	○	○	○
Eu passo muito tempo a fazer coisas para ter uma aparência mais atlética	○	○	○	○	○
Eu penso muito em ter uma aparência atlética	○	○	○	○	○
Tenho uma atitude positiva em relação ao meu corpo	○	○	○	○	○
Estou atento(a) às necessidades do meu corpo	○	○	○	○	○
Sinto-me confortável no meu corpo	○	○	○	○	○

Por último, em relação à COVID-19...

- ◯ Tanto quanto sei, não estou nem nunca estive infetado/a com o novo coronavírus (SARS-CoV-2)
- ◯ Estive infetado com o novo coronavírus (SARS-CoV-2)

Teve sintomas de COVID-19?

- ◯ Não tive qualquer sintoma de COVID-19, ficando em isolamento no domicílio
- ◯ Tive sintomas ligeiros de COVID-19 e não foi preciso ser internado(a), ficando em isolamento no domicílio (autocuidados)
- ◯ Tive sintomas ou complicações severas, da COVID-19, com necessidade de recorrer às urgências e/ou hospitalização

Ainda tem sequelas devido a ter sido infetado(a) com o COVID-19?

- ◯ Sim. Quais? ____
- ◯ Não
- ◯ Não sei responder

As suas respostas foram registadas com sucesso!

Para efeitos de tratamento de dados necessitamos de criar um código único e anónimo para cada participante. Queira, por favor, preencher os campos em baixo:

Primeira letra do seu nome e primeira letra do apelido (p.ex. MS para Marta Santos)

____

Dia, mês e últimos dois dígitos do ano de aniversário (p.ex. 051070 para 5 de Outubro de 1970)

____

Annex II: Questionnaire applied to participants within the scope of the SUFHA study – Stand up for healthy aging which makes up study 5.

****

Questionário SUFHA

Consentimento

Caro/a participante do SUFHA,
Desde já agradecemos o seu interesse em participar neste estudo científico. É objetivo deste estudo perceber, de que forma a alteração no contexto laboral poderá impactar ao nível do comportamento e escolhas alimentares, bem-estar e qualidade de vida, nível de fadiga e dor musculoesquelética e ainda em termos de produtividade. Tal permitirá não só o avanço do conhecimento, mas também o desenvolvimento de melhores práticas de promoção de saúde no contexto laboral, que podem ser posteriormente alargadas a uma escala maior.

Neste âmbito, pedimos-lhe p.f. que preencha um breve questionário online (demora cerca de 20 minutos), de forma a aferirmos alguns dos seus comportamentos de saúde. Não há respostas certas ou erradas. Pedimos-lhe apenas que responda com verdade, de forma ponderada e tão completa quanto possível. As suas respostas serão codificadas cumprindo a legislação aplicável em matéria de proteção de dados: os dados recolhidos são anónimos, confidenciais, protegidos de forma segura e acessíveis apenas à equipa de investigação. As respostas serão analisadas de forma agrupada, e nunca de forma individual. A sua participação neste questionário é totalmente voluntária.

Agradecemos desde já a sua colaboração, a sua participação é muito importante!

Declaro que li e...

- ○ ACEITO as condições da minha participação
- ○ NÃO ACEITO as condições da minha participação

Pedimos que coloque aqui o seu código de identificação (por exemplo, suf01)

____

Pedimos que coloque aqui o seu peso medido

	40 62 84 106 128 150
Kilogramas	

Pedimos que coloque aqui a sua altura medida

	140 150 160 170 180 190 200
Centímetros	

Pedimos que coloque aqui o seu perímetro de cintura medido

	30 40 50 60 70 80 90 100 110 120 130
Centímetros	

Qual é a sua idade, em anos?

	18 30 43 55 68 80
Idade	

Sexo

- ◯ Feminino
- ◯ Masculino
- ◯ Outro / Prefiro não dizer

Qual a sua nacionalidade?

____

Qual a sua naturalidade?

____

Profissão / Função dentro da ULHT

○ Serviços Académicos e Administrativos (p. ex: SATA, PUI, Suporte adicional, Serviços académicos, Recursos humanos)

○ Serviços Financeiros (p. ex: Direção financeira, Tesouraria)

○ Serviços de Gestão e Administração (p. ex: DMK, DGPA, Reitoria, Administração)

○ Outra. Qual? ____

Tempo de serviço / Há quantos anos trabalha nesta instituição?

	1	10	18	27	35
Anos de trabalho					

Em média, quantas horas trabalha por dia?

▼ 1 hora por dia ... 24 horas por dia

Qual o nível de escolaridade mais elevado que concluiu?

○ Não concluiu a Instrução Primária

○ Instrução Primária

○ Ensino Básico (9º ano)

○ Ensino Secundário (12º ano)

○ Licenciatura

○ Mestrado

○ Doutoramento

Como classifica a sua situação financeira atual?

○ Muito difícil

○ Difícil

○ Suficiente para as necessidades

○ Confortável

○ Muito confortável

Como é que se desloca? Qual a sua forma mais habitual de se deslocar entre lugares (p.ex. entre casa e a universidade)?

○ A pé ou de bicicleta (não elétrica)

○ Bicicleta ou trotinete (elétrica)

○ Transportes públicos

○ Carro ou mota

Atualmente fuma?

○ Não e nunca fumei

○ Não, mas já fumei

○ Fumo ocasionalmente

○ Fumo diariamente

Quantos cigarros fuma, em média, por dia?

	1	7	14	20
Nº de cigarros				

Tem alguma doença crónica (física ou psíquica) ou incapacidade diagnosticada por um médico?

○ Não

○ Sim. Qual/quais? ____

Toma algum tipo de medicação?

○ Não

○ Sim. Qual/quais? ____

A Universidade Lusófona preocupa-se em promover comportamentos saudáveis (p.ex. atividade física e alimentação).

- ◯ Discordo totalmente
- ◯ Discordo parcialmente
- ◯ Não concordo nem discordo
- ◯ Concordo parcialmente
- ◯ Concordo totalmente

Costuma praticar atividade física estruturada (p.ex., corrida, caminhada, exercício no ginásio, dança ou atividades desportivas)?

- ◯ SIM, costumo praticar atividade física estruturada
- ◯ NÃO, não costumo praticar atividade física estruturada

Indique quão frequentemente, no último mês...

	Nunca	Poucas vezes	Algumas vezes	Muitas vezes	Sempre que possível
1. Subiu escadas em vez de utilizar elevadores ou escadas rolantes (p.ex. no seu prédio, em centros comerciais, no local de trabalho etc.).	◯	◯	◯	◯	◯
2. Escolheu estar em pé em situações em que podia estar sentado (p.ex. enquanto fala ao telefone, enquanto espera em locais públicos ou pelo transporte etc.).	◯	◯	◯	◯	◯

As próximas questões referem-se ao tempo que passa sentado(a) / reclinado(a) / deitado(a), diariamente, na universidade, em casa, no trabalho, nos transportes ou outros contextos e durante os tempos livres (não inclua o tempo que passa a dormir).

Quanto tempo esteve sentado/a num dia típico de semana?

Horas/minutos

▼ 30 minutos ... 20 horas

Quanto tempo esteve sentado/a num dia típico de fim de semana?

Horas/minutos

▼ 30 minutos ... 20 horas

Habitualmente, quando está sentado, quão frequentemente se costuma levantar?

- ○ Estou mais de 3 horas sem me levantar
- ○ Estou mais de 1 hora sem me levantar
- ○ Levanto-me de hora em hora
- ○ Levanto-me, pelo menos de meia em meia hora

Fadiga geral e no trabalho

Em baixo irá encontrar um conjunto de afirmações que poderão descrever a sua situação. Para cada uma das seguintes frases **indique como se sente, no geral**, utilizando a seguinte escala de resposta:

	Nada	Um pouco	Moderadamente	Muito	Extremamente
1. Não me sinto com energia.	○	○	○	○	○
2. Tudo o que eu faço requer esforço.	○	○	○	○	○
3. Sinto-me fraco em determinadas partes do meu corpo.	○	○	○	○	○
4. Sinto as minhas pernas ou os meus braços pesados.	○	○	○	○	○
5. Sinto-me cansado sem motivo aparente.	○	○	○	○	○
6. Tenho vontade de me deitar para descansar.	○	○	○	○	○
7. Tenho dificuldades em concentrar-me.	○	○	○	○	○
8. Sinto-me cansado, pesado e rígido.	○	○	○	○	○

NFR (RecScale)
Para cada uma das questões que se seguem, assinale a opção que melhor descrever a sua **situação atual**.

	Não	Sim
1. É difícil relaxar no final de um dia ocupado.	○	○
2. No final de um dia ocupado, sinto-me esgotado(a).	○	○
3. Devido às minhas atividades, no final do dia, sinto-me exausto(a).	○	○
4. Depois de jantar, sinto-me em boa forma.	○	○
5. Só começo a sentir-me relaxado(a) ao 2º dia de descanso.	○	○
6. Tenho dificuldade em concentrar-me no meu tempo livre, depois do trabalho ou tarefas diárias.	○	○
7. Quando chego a casa do trabalho ou após as minhas tarefas diárias, não consigo ter vontade de estar com outras pessoas.	○	○
8. Depois do trabalho ou das minhas tarefas diárias, preciso de pelo menos uma hora para me sentir completamente recuperado(a).	○	○
9. Quando chego a casa do trabalho ou após as minhas tarefas diárias, preciso que "me deixem em paz" durante algum tempo.	○	○
10. Depois de um dia de trabalho ou outros deveres, sinto-me tão cansado(a) que não consigo fazer mais nada.	○	○
11. A sensação de cansaço que tenho impede-me de fazer, ao mesmo ritmo, o meu trabalho ou outras tarefas diárias ao longo do dia.	○	○

Nas **duas últimas semanas,** por quanto tempo teve **dificuldade ou incapacidade** nas seguintes situações:

	Nenhuma parte do tempo (0%)	Uma pequena parte do tempo	Alguma parte do tempo (cerca de 50%)	A maior parte do tempo	O tempo todo (100%)
1. Trabalhar as horas que me são solicitadas.	○	○	○	○	○
2. Comec77ar as suas tarefas assim que chega ao trabalho.	○	○	○	○	○
3. Fazer os mesmos movimentos, repetidamente durante o trabalho.	○	○	○	○	○
4. Utilizar o equipamento de trabalho (i.e.: telefone, caneta, teclado, rato...).	○	○	○	○	○
5. Concentrar-se no trabalho.	○	○	○	○	○
6. Ajudar os outros a acabar o trabalho.	○	○	○	○	○
7. Desenvolver a quantidade de trabalho que me é solicitada.	○	○	○	○	○
8. Sentir que devia ter feito aquilo que sou capaz de fazer.	○	○	○	○	○

Qualidade de vida - EUROHIS-QOL-8

As próximas questões procuram conhecer a sua **qualidade de vida, saúde e outras áreas da sua vida**. Por favor, responda a todas as perguntas, optando sempre pela opção que lhe parecer mais apropriada.

Tendo em conta as **duas últimas semanas**:

	Muito má	Má	Nem boa nem má	Boa	Muito boa
Como avalia a sua qualidade de vida?	○	○	○	○	○

Tendo em conta as **duas últimas semanas**:

	Nada	Pouco	Moderadamente	Bastante	Completamente
Tem energia suficiente para a sua vida diária?	○	○	○	○	○
Tem dinheiro suficiente para satisfazer as suas necessidades?	○	○	○	○	○

Tendo em conta as **duas últimas semanas**:

	Muito insatisfeito	Insatisfeito	Nem satisfeito nem insatisfeito	Satisfeito	Muito satisfeito
Até que ponto está satisfeito(a) com a sua saúde?	○	○	○	○	○
Até que ponto está satisfeito(a) com a sua capacidade para desempenhar as atividades do seu dia-a-dia?	○	○	○	○	○
Até que ponto está satisfeito(a) consigo próprio(a)?	○	○	○	○	○
Até que ponto está satisfeito(a) com as suas relações pessoais?	○	○	○	○	○
Até que ponto está satisfeito(a) com as condições do lugar em que vive?	○	○	○	○	○

Bem-estar - WHO-5

Indique, por favor, para cada uma das cinco afirmações, a opção que mais se aproxima do **modo como se tem sentido nas últimas 2 semanas**.

Exemplo: Se se sentiu alegre e bem-disposto(a), durante mais da metade do tempo, assinale na 1ª linha a opção na 5ª coluna.

Durante as últimas 2 semanas...

	Nunca	Algumas vezes	Menos da metade do tempo	Mais da metade do tempo	A maior parte do tempo	Todo o tempo
1. Senti-me alegre e bem-disposto(a).	○	○	○	○	○	○
2. Senti-me calmo(a) e tranquilo(a).	○	○	○	○	○	○
3. Senti-me ativo(a) e enérgico(a).	○	○	○	○	○	○
4. Acordei e senti-me fresco(a) e repousado(a).	○	○	○	○	○	○
5. O meu dia-a-dia tem sido preenchido com coisas que me interessam.	○	○	○	○	○	○

UWES-9

As seguintes afirmações referem-se ao **modo como se sente no trabalho**. Por favor, leia as mesmas com atenção e pense se alguma vez se sente assim em relação ao seu trabalho. Se nunca teve esta sensação, por favor assinale "nunca" na escala. Se já teve esta sensação, assinale a frequência com que a sente, entre "algumas vezes ao longo do ano ou menos" e "todos os dias", que melhor descreve a sua situação.

	Nunca	Algumas vezes por ano ou menos	Uma vez por mês ou menos	Algumas vezes por mês	Uma vez por semana	Algumas vezes por semana	Todos os dias
1. No meu trabalho sinto-me cheio(a) de energia.	○	○	○	○	○	○	○
2. No meu trabalho sinto-me com força e energia.	○	○	○	○	○	○	○
3. Estou entusiasmado(a) com o meu trabalho.	○	○	○	○	○	○	○
4. O meu trabalho inspira-me.	○	○	○	○	○	○	○
5. Quando me levanto de manhã apetece-me ir trabalhar.	○	○	○	○	○	○	○
6. Sinto-me feliz quando estou a trabalhar intensamente.	○	○	○	○	○	○	○
7. Estou orgulhoso(a) do que faço neste trabalho.	○	○	○	○	○	○	○
8. Estou imerso(a) no meu trabalho.	○	○	○	○	○	○	○
9. "Deixo-me ir" quando estou a trabalhar.	○	○	○	○	○	○	○

Adesão à Dieta Mediterrânica
Com que **frequência** consome...

Cereais não refinados (pão integral/de mistura, massa e arroz integral, etc.)
1 porção equivale a 1 fatia de pão/1 bola, ½ chávena de arroz ou massa.

○ Nunca

○ 1-6 porções regulares por semana

○ 7-12 porções regulares por semana

○ 13-18 porções regulares por semana

○ 19-31 porções regulares por semana

○ >=32 porções regulares por semana

Batatas
1 porção equivale a ½ chávena de batata cozida/puré, 1 chávena de batatas fritas, 1,5 batatas cruas.

- ○ Nunca
- ○ 1-2 porções regulares por semana
- ○ 3 porções regulares por semana
- ○ 4 porções regulares por semana
- ○ >=5 porções regulares por semana

Fruta
1 porção equivale a 1 peça de fruta média, por exemplo, 1 maçã/laranja, 1 banana pequena, 1 fatia de melancia/melão, 10-12 cerejas/morangos/uvas.

- ○ Nunca
- ○ 1-4 porções regulares por semana
- ○ 5-8 porções regulares por semana
- ○ 9-15 porções regulares por semana
- ○ 16-21 porções regulares por semana
- ○ >=22 porções regulares por semana

Hortícolas (crus ou cozinhados)
1 porção equivale a 1 chávena almoçadeira de hortícolas crus e ½ chávena cozinhados.

- ○ Nunca
- ○ 1-6 porções regulares por semana
- ○ 7-12 porções regulares por semana
- ○ 13-20 porções regulares por semana
- ○ 21-32 porções regulares por semana
- ○ >=33 porções regulares por semana

Leguminosas (grão, feijão, ervilhas, etc.)
1 porção equivale a 1 chávena.

- ◯ Nunca
- ◯ 1-2 porções regulares por semana
- ◯ 3-4 porções regulares por semana
- ◯ 5-6 porções regulares por semana
- ◯ >=7 porções regulares por semana

Peixe (e derivados do mar)
1 porção equivale a 120g de peixe cozinhado.

- ◯ Nunca
- ◯ < 1 porção regular por semana
- ◯ 1-2 porções regulares por semana
- ◯ 3-4 porções regulares por semana
- ◯ 5-6 porções regulares por semana
- ◯ >=7 porções regulares por semana

Carnes vermelhas e produtos de charcutaria
1 porção equivale a 120g de carne cozinhada.

- ◯ ≤1 porção regular por semana
- ◯ 2-3 porções regulares por semana
- ◯ 4-5 porções regulares por semana
- ◯ 6-7 porções regulares por semana
- ◯ 8-10 porções regulares por semana
- ◯ >=11 porções regulares por semana

Carnes brancas (de aves)
1 porção equivale a 120g de carne cozinhada.

○ ≤3 porções regulares por semana

○ 4 porções regulares por semana

○ 5-6 porções regulares por semana

○ 7-8 porções regulares por semana

○ 9-10 porções regulares por semana

○ >=11 porções regulares por semana

Lacticínios gordos (queijo, iogurte, leite)
1 porção equivale a 1 chávena de leite, 1 iogurte de 180g, 30g de queijo; se consome apenas leite meio-gordo ou magro, escolher a opção ≤10 porções regulares por semana.

○ ≤10 porções regulares por semana

○ 11-15 porções regulares por semana

○ 16-20 porções regulares por semana

○ 21-28 porções regulares por semana

○ 29-30 porções regulares por semana

○ >=31 porções regulares por semana

Uso de azeite na confeção

○ Nunca

○ Raramente

○ 1-3 vezes por semana

○ 3-5 vezes por semana

○ Diariamente

○

Bebidas alcoólicas
1 copo de vinho = 100ml

○ 0 ml/dia

○ 300 ml/dia

○ 400 ml/dia

- 500 ml/dia
- 600 ml/dia
- >=700 ml/dia

Numa semana típica, quantas vezes...

	Nunca	1-2 vezes	3-5 vezes	6 ou mais vezes
1. Toma pequeno-almoço?	○	○	○	○
2. Salta refeições principais (almoço/jantar)?	○	○	○	○
3. Come refeições caseiras confecionadas por si/familiares/amigos?	○	○	○	○
4. Come em restaurantes/bares/cafés ou encomenda comida (take away)?	○	○	○	○
5. Come refeições rápidas (fast food)?	○	○	○	○

Para cada afirmação que se segue, indique **quão verdadeira/aplicável** é para si...

	Nada verdadeiro no meu caso	Um pouco verdadeiro no meu caso	Às vezes	Muito verdadeiro no meu caso	Totalmente verdadeiro no meu caso
1. Dou por mim a comer quando me sinto mais ansioso(a), depressivo(a) ou triste, mesmo que não esteja fisicamente com fome.	○	○	○	○	○
2. Recuso comidas ou bebidas porque controlo o meu peso.	○	○	○	○	○
3. Como menos do que habitualmente quando comi demasiado na véspera.	○	○	○	○	○
4. Vigio exatamente o que como.	○	○	○	○	○
5. Eu confio no meu corpo para me alertar quando devo comer.	○	○	○	○	○
6. Eu confio no meu corpo para me alertar da quantidade que devo comer.	○	○	○	○	○
7. Habitualmente, escolho alimentos que ajudam o meu corpo a funcionar melhor.	○	○	○	○	○
8. Por vezes, quando começo a comer não consigo parar.	○	○	○	○	○
9. Estar com alguém que está a comer, faz-me querer comer também.	○	○	○	○	○
10. Quando vejo um prato com aspeto delicioso ou sinto o cheiro de comida apetitosa não resisto a comer, mesmo que tenha acabado há pouco tempo uma refeição.	○	○	○	○	○

Desconforto musculoesquelético

Por favor, responda a cada questão assinalando a opção mais apropriada. Marque apenas uma opção por cada questão. Não deixe nenhuma questão em branco, mesmo se não tiver nenhum problema em qualquer parte do corpo. Para responder, considere as regiões do corpo conforme ilustra a figura abaixo.

Teve algum problema nos **<u>últimos 7 dias</u>**, nas seguintes regiões:

Pescoço?

- Não
- Sim

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	11	
Sem Dor												Dor Máxima

Ombros?

- Não
- Sim

Em que região?

- , no ombro direito
- , no ombro esquerdo
- , em ambos

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	11	
Sem Dor												Dor Máxima

Cotovelo?

- Não
- Sim

Em que região?

- , no cotovelo direito
- , no cotovelo esquerdo
- , em ambos

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	11	
Sem Dor	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Dor Máxima

Punho/mãos?

◯ Não

◯ Sim

Em que região?

◯ , no punho/mãos direitos

◯ , no punho/mãos esquerdos

◯ , em ambos

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	11	
Sem Dor	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Dor Máxima

Região Torácica?

◯ Não

◯ Sim

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	11	
Sem Dor	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Dor Máxima

Região Lombar?

◯ Não

◯ Sim

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	
Sem Dor	○	○	○	○	○	○	○	○	○	○	Dor Máxima

Ancas/Coxas?

○ Não

○ Sim

Numa escala de 0 a 10, por favor quantifique a sua dor

	1	2	3	4	5	6	7	8	9	10	
Sem Dor	○	○	○	○	○	○	○	○	○	○	Dor Máxima

Annex III: Opinion of the Faculty of Physical Education and Sport ethics committee within the scope of the LusófonAtiva Project.

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UNIVERSIDADE LUSÓFONA
I Faculdade de Educação Física e Desporto

Comissão de Ética da Faculdade de Educação Física e Desporto -ULHT

Parecer

A Comissão de Ética da Faculdade de Educação Física e Desporto – ULHT, em reunião de 20 de Janeiro de 2021, analisou o projeto que tem por investigadora principal **Marlene Nunes Silva,** subordinado ao tema *Monitorização e Promoção de Estilos de Vida Ativos e Saudáveis em alunos, docentes e funcionário*, tendo decidido emitir parecer positivo sem recomendações.

O Diretor da Comissão de Ética da FEFD – ULHT

(José Gregório Viegas Brás)

Annex IV: Opinion of the ethics committee of the Faculty of Physical Education and Sports within the scope of the SUFHA study.

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UNIVERSIDADE LUSÓFONA
| Faculdade de Educação Física e Desporto [redacted]

Comissão de Ética da Faculdade de Educação Física e Desporto -ULHT

Parecer D0522

A Comissão de Ética da Faculdade de Educação Física e Desporto – ULHT, em reunião de 5 de Dezembro de 2022, analisou o projeto *The impact of introducing sit-stand desks in the workplace for healthy aging: a randomized controlled trial in sedentary adults*, com o acrónimo designado por *SUFHA (Stand Up For Healthy Aging)*, a realizar por quatro centros de investigação (Centro Investigação em Desporto, Educação Física, Exercício e Saúde -*CIDEFES* da Faculdade de Educação Física e Desporto; Centro de Investigação em Comunicação Aplicada, Cultura e Novas Tecnologias - *CICANT*- da Escola de Comunicação, Arquitetura, Artes e Tecnologias da Informação, *COW* - Centro de Investigação em Design e Arte - Center for Other Worlds, e *HEI-LAB* – Human Environment Interaction laboratory), cujo investigador principal é o **Pedro Júdice**, tendo decidido emitir parecer positivo sem recomendações.

O Diretor da Comissão de Ética da FEFD – ULHT

(Prof. Doutor José Gregório Viegas Brás)

Annex V: Scientific production complementary to the work integrated into the thesis

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1. **Artigo publicado como primeira autora em:** Cities and Health on November, 2023.

Correlates associated with the compliance for moderate, vigorous, and overall physical activity recommendations of public park users in Oeiras – Portugal

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Teno, S. C., Silva, H., & Júdice, P. B. (2023). Correlates associated with the compliance for moderate, vigorous, and overall physical activity recommendations of public park users in Oeiras – Portugal. *Cities & Health*, *8*(1), 59–69. https://doi.org/10.1080/23748834.2023.2280354

Abstract

A cross-sectional study with data from 403 users from public parks in Oeiras – Portugal was conducted to measure their amount of physical activity and sedentary behavior, and investigate the distinct correlates associated with the chance of complying with the overall, moderate, and vigorous physical activity recommendations by the World Health Organization. We collected sociodemographic data, physical activity, sedentary behavior, the prevalence of disease, amount and quality of sleep, subjective well-being, where and with whom they live, and the usual way of commuting. Descriptive analysis and binary logistic regression models were used, and the results indicated that 75.2% of the Oeiras' public park users met the overall physical activity guidelines from the World Health Organization and accumulated 315 min/day (±165) of sedentary behavior. Besides that, the main correlates associated with a lower compliance to physical activity recommendations were a higher sedentary behavior (for total, moderate, and vigorous physical activity) and age (for total and vigorous physical activity), a lower education level (for total and moderate physical activity), lower sleep quality (only for moderate physical activity), and "seeming sad" at the moment of the interview (for total, moderate, and vigorous physical activity).

Keywords: sedentary behavior; guidelines; green spaces; environmental, physical inactivity

1. Introduction

The World Health Organization (WHO) recommends the practice of 150–300 min of moderate intensity physical activity or 75–150 min of vigorous intensity per week, or an equivalent combination (Bull et al., 2020) for benefits in health. The benefits include a lower risk of cardiovascular disease, hypertension, obesity, diabetes, and breast and colon cancer (Pedersen & Saltin, 2015) and improved quality of life and well-being (Marquez et al., 2020). Moreover, physical activity in green spaces or outdoor spaces has been described to promote health and well-being through exposure to pleasant environments and encouraging health promotion behaviors (Lovell et al., 2014).

The WHO also recommends the reduction of sedentary behavior, which is defined as any activity while awake, with ≤1.5 metabolic equivalents, in a seated or reclining posture (Tremblay et al., 2017). Excessive sedentary behavior accumulation is associated with all-cause mortality, cardiovascular disease, type II diabetes, abdominal obesity, some types of cancer, and depression (Júdice et al., 2015; Patterson et al., 2018; Wang et al., 2019). In addition, sedentary behavior is negatively associated with physical activity, mainly in low intensities, and although it has a weak association with moderate physical activity (Mansoubi et al., 2014), it can reduce the chance of meeting the recommendations.

Despite these recommendations, data from the Eurobarometer (*Desporto e atividade física - Setembro 2022 - Inquérito Eurobarómetro*, 2022) with 28 countries of the European Union indicate that Portugal has one of the highest prevalences of physical inactivity, defined as noncompliance with the recommended amount of physical activity (Thivel et al., 2018), with just 4% of the population performing regularly and 72% never performing physical activity. In addition, in the same report, 20% of the interviewed reported spending between 5 h 31 min/day and 8 h 30 min/day in sedentary behavior, and 9% reported spending more than 8 h 31 min/day in sedentary behavior. These values are considered troubling, given that the data of the prospective studies indicate that for each sitting hour, the risk of all-cause mortality increases by 2%, and this risk can rise up to 5% in the case of more than 7 hours of sitting per day, independent of physical activity levels (Chau et al., 2013).

Previous systematic reviews indicate that the built environment, the quality of urban infrastructures, and the installation of fitness equipment or spaces for walking or bicycle use favor the practice of physical activity (Smith et al., 2017). For example, an investigation using the System for Observing Play and Recreation in Communities (SOPARC), assessed park users and their physical activity levels before and after two parks were renovated, and compared them to parks that have not been renovated (Cohen et al., 2015). The new parks doubled the number of visitors and a substantial increase in energy expended in the parks (Cohen et al., 2015). However, many of these investigations do not use valid instruments to capture the intensity or the frequency of physical activity, and do not consider other variables that can be positively associated (or negatively) with the compliance of physical activity recommendations, i.e., their correlates. Prior investigations have explored the correlates associated with physical activity with the aim of understanding how these factors associate with behavior over the lifespan(Bauman et al., 2012) . For example, a study with Swedish adults found that those aged < 35 years, living in small towns and villages, having a body mass index < 29.9 kg/m^2, or having a very good or excellent self-perceived health were more likely to reach the physical activity recommendations (Bergman et al., 2008). In the same study, the less likely to reach the recommendations were women and those with a university degree. Furthermore, most studies analyze the fulfillment of overall physical activity recommendations, and do not go deeper on the correlates for the moderate intensity recommendation and the correlates for the vigorous one, which we believe can be very different. In fact, some intensities can be more appropriate and impactful to specific groups. For example, a systematic-review on 1039 randomized control trials indicated that moderate-intensity exercise had a more significant effect on anxiety reduction (compared to mild and vigorous), while vigorous-intensity exercise was better for depression(Singh et al., 2023). In diabetic patients, vigorous-intensity exercise (aerobic and strength) had better efficacy for glycemic control, as well as increased insulin sensitivity and pancreatic β cell function in adults(Kanaley et al., 2022). Thus, recommending physical activity of a specific intensity may also entail specific correlates, which deserved our attention.

Thus, acknowledging the importance of the built environment and public infrastructures to increase physical activity levels, and taking into a count the above described, this investigation aimed to measure the amount of physical activity and sedentary behavior the public parks users in a Portuguese city, and to identify the correlates associated with the chance of compliance with the recommendations by WHO, while differentiating the two main guidelines (i.e., moderate, or vigorous) that can potentially imply distinct correlates, thus, facilitating the development of effective interventions to promote active people.

2. Methods

This investigation was conducted according to the STROBE guidelines (von Elm et al., 2007).

2.1.Study design and settings

This is cross-sectional data from an observational investigation carried out through a questionnaire applied by face-to-face interview in public areas of the municipality of Oeiras/Portugal. This investigation was carried out with data from a larger study that aimed to describe the profile of public park users in the city of Oeiras, regardless of where they lived. The main goal of the current investigation was to measure the amount of physical activity and sedentary behavior of the public parks users and to identify the correlates associated with the chance of complying with current WHO guidelines.

Oeiras is a Portuguese city, in the metropolitan area of Lisbon, with an area of 45.88 km^2 and with 171,767 inhabitants (Census, 2021). Oeiras is one of the cities with the highest gross income per person in the country (18,456 €), more than the national median (12,568 €) (*Estatísticas do rendimento ao nível local - 2020*, 2022). Oeiras has 26 gardens (*Espaço Verdes*, 2023) and green spaces dedicated to meetings, sports, and recreation, which we chose 9 outdoor infrastructures for the practice of physical activity (or exercise), such as green parks, outdoor fitness equipment, and walking/running paths with distinct contexts (e.g., close to the ocean, in an urban setting). The data collection visits took place between March and April 2022, as presented in Figure 1, the chosen infrastructures were:

- Seaside promenade - Paço de Arcos' beach – area dedicated to running, walking, cycling, rollerblading, etc.
- Seaside promenade – Oeiras' Marina – area dedicated to running, walking, cycling, rollerblading, etc.
- Seaside promenade – Santo Amaro´s beach – area dedicated to running, walking, cycling, rollerblading, etc.
- Seaside promenade – Caxias' beach - area dedicated to running, walking, cycling, rollerblading, etc.
- Jamor's Urban park - Green area inside of National Sports Center of Jamor, with equipment fitness outdoor and several options to distinct physical activities practice.
- Miraflores' Urban park - Green area, with equipment fitness outdoor and several options for physical activities practice.

- Equipment fitness outdoor - Tower's beach
- Equipment fitness outdoor - Oeiras' Forum
- Equipment fitness outdoor - Paço de Arcos

Places with fitness infrastructures chosen for data collection (N participants at each point)

(1) Seaside promenade - Paço de Arcos' beach (93)
(2) Seaside promenade - Oeiras' Marina (65)
(3) Seaside promenade - Santo Amaro´s beach (28)
(4) Seaside promenade - Caxias' beach (36)
(5) Jamor's Urban park (72)
(6) Miraflores' Urban park (75)
(7) EFO - Tower's beach (8)
(8) EFO - Oeiras' Forum (7)
(9) EFO - Paço de Arcos (19)

Figure 1: Places with fitness infrastructure chosen for data collection.
Abbreviation: EFO: equipment fitness outdoor

The interviews were performed by well-trained interviewers recruited and instructed for the purpose of this study. First, they explained the goal of the investigation to potential participants and that their participation would be voluntary, meaning that they could give up at any time and that no personal data would be necessary, only their answers. The study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of Universidade Lusófona under the number J1822, on January 18, 2022, and the participants gave their informed consent prior to participation in the study.

2.2.Participants

A convenience sample of 403 participants was recruited, and the approach was performed over people who were using outdoor public infrastructures and invited to participate in the survey, regardless of where they lived. The main inclusion criteria were being adult (> 18 years old) and being available to answer the questions for a few minutes. The description of how many participants were evaluated at each point is described in Table 1.

2.3. Main Variables

- Physical activity**:** Physical activity was assessed with the short version of the International Physical Activity Questionnaire (IPAQ). The short version has been shown to have acceptable test-retest reliability (rho = 0.8) and criterion-related validity compared with accelerometers (rho = 0.3) in a 12-country evaluation study that included Portugal (Craig et al., 2003). The IPAQ assesses total physical activity by asking the frequency (the number of days per week) and duration (the average time in minutes per day) that a person performed vigorous and moderate intensity physical activity, and walking. The responses were then categorized into “meeting overall recommendations” (≥150 min/week of moderate or ≥ 75 min/week of vigorous physical activity) or “not meeting the overall recommendations” (<150 min/week of moderate or <75 min/week of vigorous physical activity), “meeting the recommendations for moderate intensity” (≥ 150 min/week of moderate-intensity PA) or “not meeting the recommendations for moderate intensity”, and finally “meeting the recommendations for vigorous intensity” (≥ 75 min/week of vigorous PA) or “not meeting the recommendations for vigorous intensity”, according to the WHO guidelines.
- Sedentary behavior: Sedentary behavior was also assessed using the IPAQ by asking the duration (the average time in hours per day) that the person spends sitting during the weekdays and weekends. The answers were weighted by day [min/day]) through the weighted arithmetic media of the responses of the time in sedentary behavior on weekdays and weekend days and then also transformed into a categorical variable: low (≤ 180 min/day), medium (181 – 419 min/day), and high sedentary behavior (≥ 420 min/day), according to previous cut points (Chau et al., 2013; Rezende et al., 2016).

2.4.Covariates

Based on previous evidence(Bakker et al., 2020; Bauman et al., 2012; Bergman et al., 2008; Dolezal et al., 2017; Marquez et al., 2020) about the associations of physiological and psychosocial variables with physical activity and sedentary behavior, the following covariates were included in the statistical models.

- Continuous covariates: age and body weight, which were self-referred to in the questionnaire, and them the BMI calculated as weight/height2 [kg/m2]. The hours of sleep were based on the questions “what time do you go to bed” and “what time do you wake up in the morning in most of your days"?). We also assessed their subjective well-being through one item from "the scale of life satisfaction"(Diener et al., 1985). The question was "Overall, how satisfied are you with life these days? Nothing was "0" satisfied and "10" extremely satisfied.

- Categorical covariates: sex (male/female), prevalence of disease ("Do you have a disease diagnosis made by a doctor? yes/no"), the level of education completed (What is your highest completed educational level? less than high school, high school, and graduated [classified as bachelor or more]), if lived alone or accompanied (alone/accompanied), housing area (living in the Oeiras municipality - yes/no), the most common way to commute (i.e., by car/motorcycle, by public transportation, by walking or by bicycle), perception of financial status (i.e., very difficult, difficult, enough to pay the bills, comfortable, very comfortable), and sleep quality in a binary manner (i.e., sleeping continuously? yes/no). Finally, at the end of the questionnaire, the interviewers subjectively assessed if the responders looked "happy or sad" at the moment of the interview, according to his/her perception during the interview (for example: if they were smiling, in a good mood, with a "fresh air" and comfortable with the interview etc.).

2.5.Statistical analysis

Binary logistic regression models were used to identify the correlates associated with 1) meeting overall physical activity recommendations, 2) meeting moderate intensity recommendation and 3) meeting vigorous intensity physical activity recommendation, using a manual backward elimination approach (p value for removal set at 0.05). The model started with all the variables (complete model), and then being removed one by one in the order of least significance, thus mathematically finding the model with the best fit for the adherence to guidelines (overall, moderate, and vigorous) (final model). Collinearity diagnostic tests were performed for all independent variables to comply with the assumptions of the logistic regression analysis. Odd ratios and 95% confidence intervals were calculated, and a p value <0.05 was considered statistically significant. The chance estimates were presented in the final model. The software used was The Jamovi Project, version 2.2. The odd ratios were calculated against the reference categories (i.e., men, living in Oeiras, getting around by bike, not having chronic disease, living in a very comfortable way financially, having continuous sleep, having a university degree or postgraduation, living alone, and seemed happy at the time of the face-to-face interview).

3. Results

3.1.Participants and descriptive data

Descriptive analysis was performed to describe the characteristics of the participants, and the data are presented as the mean and standard deviation for the continuous variables and frequencies for the non-continuous variables (Table 1). The sample consisted of 403 participants (N=231 women [57.3%]), with an average age of 48.5 years (± 17.1 years), ranging from 18 to 87 years, and 20.6% were older adults (≥ 65 years) (N=83). The BMI of the participants was on average 24.5 kg/m^2 (± 3.69 kg/m^2), and 58.1% had graduated (bachelor's, master's, or Ph.D. degrees), 30.5% had at least a high school education, and 11.4% had less than a high school education. The participants presented on average, 7.6 (± 1.69) subjective well-being score. Based on the IPAQ, users of public places reported performing 153 (± 291) min/week of vigorous-intensity physical activity and 417 (± 657) min/week of moderate-intensity physical activity. Regarding sedentary behavior, participants accumulated on average 315 (± 165) min/day (5.23 hours/day).

According to the WHO recommendations, 75.2% (N=303) of respondents complied with the minimum recommended weekly amount of total physical activity, while 24.8% (N=100) did not achieve these values. Compliance with moderate guideline was 56.3% (N=227), and 43.4% (N=175) attained the guideline for vigorous physical activity (more information on Table 1).

Table 1: Descriptive analysis of the sample (N=403)

Places	N	mean	± SD	%
Age (years)	403	48.5	17.1	
Age group				
18-24	37			9.2
25-39	96			23.8
39-64	187			79.4
>65 years old	83			20.6
Seaside promenade - Paço de Arcos' beach	93			23.0
Seaside promenade - Marina de Oeiras	65			16.1
Seaside promenade – Santo Amaro´s beach	28			6.9
Seaside promenade – Caxias' beach	36			8.9
Jamor's Urban park	72			17.8
Miraflores' Urban park	75			18.6
Equipment fitness outdoor Tower's beach	8			1.9
Equipment fitness outdoor Oeiras' forum	7			1.7
Equipment fitness outdoor Paço de Arcos	19			4.7
Body mass index (kg/m^2)	403	24.5	3.69	
Moderate physical activity (min/week)	403	417	657	

Vigorous physical activity (min/week)	403	153	291	
Sedentary behavior (min/day)	403	315	165	
Sleep (hours/day)	403	7.96	1.18	
Subjective well-being (scale of 0 to 10)	403	7.62	1.69	
Sedentary behavior (categories)				
High (≥ 420 min/day)	116			28.8
Medium (181 – 419 min/day)	168			41.7
Low (≤ 180 min/day)	119			29.5
Sex				
Female	231			57.3
Male	172			42.7
Do you live in Oeiras?				
Yes	238			59.1
No	165			40.9
Do you live alone or accompanied?				
Alone	70			17.4
Accompanied	333			82.6
Education level completed				
Less than high school	46			11.4
High school	123			30.5
More than Bachelor	234			58.1
Financial situation perceived				
Very difficult	6			1.5
Difficult	19			4.7
Enough to pay the bills	175			43.4
Comfortable	178			44.2
Very comfortable	25			6.2
Have a diagnosed disease?				
Yes	122			30.3
No	281			69.7
Do you sleep continuously?				
Yes	233			57.8
No	170			42.2
What is the most common way of commuting in your daily life?				
By car/motorcycle	254			63.0
By public transportation	52			12.9
By walking	92			22.8
Bicycle	5			1.2
Did the interviewees look sad or happy to the interviewers				
Happy	328			81.4
Sad	75			18.6
Met the recommendation for physical activity				
Yes	303			75.2
No	100			24.8
Met the recommendation for moderate physical activity				
Yes	227			56.3
No	176			43.7
Met the recommendation for vigorous physical activity				
Yes	175			43.4
No	228			56.6

3.2.Mains results

The test of collinearity (values of variance inflation factor [VIF]) allowed the inclusion of all variables on the model, including sedentary behavior, and all were below 1.5 in a scale of 1-5 (Akinwande et al., 2015).

Table 2 presents the models from the logistic regression to identify the correlates associated with the chance of adherence to physical activity recommendations (i.e., overall, moderate, and vigorous). For overall, after withdrawing the nonsignificant variables, those who had fewer chances to comply with the recommendations of physical activity were the oldest (b -0.034 [OR: 0.96; 95% CI = 0.95–0.98]), with just high school (b -0.677 [OR: 0.50; 95% CI = 0.29–0.88]), with higher sedentary behavior (b -1.798 [OR: 0.16; 95% CI = 0.07–0.34]), and "seemed sad" in the interview (b -0.840 [OR: 0.43; 95% CI = 0.24–0.77]).

Those who had fewer chances of complying with the recommendation of moderate physical activity were the ones belonging to the categories of medium (b -0.939 [OR: 0.39: 95% CI = 0.22–0.679]), and high sedentary behavior (b – 1.751 [OR: 0.17; 95% CI = 0.09–0.32]), lower sleep quality (b -0.504 [OR: 0.60; 95% CI = 0.39–0.93]), with just high school (b -0.683 [OR: 0.50; 95% CI: 0.31–0.82]), and "seemed sad" in the interview (b – 0.690 [OR: 0.50; 95% CI = 0.29–0.86]).

Finally, those presenting fewer chances of complying with vigorous physical activity were older (b -0.040 [OR: 0.96; 95% CI = 0.94–0.97]), with high sedentary behavior (b -0.063 [OR: 0.51; 95% CI = 0.28–0.92]), and that "seemed sad" in the interview (b -0.702 [OR: 0.50; 95% CI = 0.27–0.91]).

Table 2: Correlates associated with compliance to physical activity recommendations of public park users (overall, moderate or vigorous PA).

	Factors associated with compliance to overall PA guidelines					Factors associated with compliance to moderate PA guideline					Factors associated with compliance to vigorous PA guideline				
	Complete model		Final model			Complete model		Final Model			Complete model		Final Model		
Variables	**OR (95% CI)**	**P value**	**OR (95% CI)**	**P value**	**Estimate**	**OR (95% CI)**	**P value**	**OR (95%CI)**	**P value**	**Estimate**	**OR (95% CI)**	**P value**	**OR (95%CI)**	**P value**	**Estimate**
Age (years)	0.97 (0.95 – 0.98)	**0.001**	0.96 (0.95 – 0.98)	**<0.001**	-0.034	1.00 (0.98 – 1.01)	0.697				0.96 (0.94 – 0.97)	**<0.001**	0.96 (0.94 – 0.97)	**<0.001**	-0.040
Body mass index (kg/m^2)	0.94 (0.88 – 1.02)	0.150				0.94 (0.88 – 1.01)	0.105				0.96 (0.90 – 1.03)	0.283			
Sleep (hours/day)	0.95 (0.75 – 1.20)	0.702				1.01 (0.83 – 1.23)	0.869				0.88 (0.72 – 1.07)	0.217			
Life satisfaction (scale of 0 to 10)	1.07 (0.91 – 1.25)	0.391				1.03 (0.89 – 1.19)	0.616				1.07 (0.92 – 1.25)	0.356			
SB (category)															
Low	reference		reference			reference		reference			reference		reference		
Medium	0.53 (0.26 – 1.08)	0.082				0.40 (0.22 – 0.70)	**0.002**	0.39 (0.22 – 0.67)	**<0.001**	-0.939	0.99 (0.57 – 1.72)	0.980			
High	0.15 (0.06 – 0.33)	**<0.001**	0.16 (0.07 – 0.34)	**<0.001**	-1.798	0.15 (0.08 – 0.30)	**<0.001**	0.17 (0.09– 0.32)	**<0.001**	-1.751	0.47 (0.24 – 0.89)	**0.021**	0.51 (0.28 – 0.92)	**0.027**	-0.063
Live in Oeiras															
Yes	reference					reference					reference				
No	1.06 (0.62 – 1.82)	0.814				1.18 (0.75 – 1.86)	0.456				0.90 (0.57 – 1.41)	0.652			
Way of transport															
By bike	reference					reference					reference				
Transport by car/motorcycle	1.12 (0.09 – 12.9)	0.925				0.29 (0.02 – 3.28)	0.319				0.89 (0.12 – 6.60)	0.917			
Walk	0.95 (0.07 – 11.5)	0.969				0.21 (0.01 – 2.47)	0.216				0.88 (0.11 – 6.71)	0.902			
Public transport	1,04 (0.08 – 12.9)	0.974				0.21 (0.01 – 2.46)	0.214				0.72 (0.09 – 5.62)	0.756			
Diagnosed disease															
No	reference					reference					reference				
Yes	0.83 (0.46 – 1.49)	0.536				0.79 (0.47 – 1.33)	0.387				0.79 (0.46 – 1.35)	0.391			
Perceived financial situation															
Very comfortable	reference					reference					reference				
Comfortable	0.92 (0.31– 2.70)	0.883				1.20 (0.47 – 3.03)	0.698				0.40 (0.15 – 1.06)	0.067			
Enough to pay the bills	0.87 (0.30– 2.55)	0.810				1.04 (0.40 – 2.63)	0.934				0.57 (0.21 – 1.49)	0.254			
Difficult	0.98 (0.20 – 4.82)	0.988				1.51 (0.37 – 6.08)	0.560				1.28 (0.30 – 5.31)	0.731			
Very difficult	4.02 (0.26 – 62.1)	0.313				9.22 (0.72 – 117)	0.087				0.33 (0.02 – 3.85)	0.381			
Sleep quality															
Yes	reference					reference		Reference			reference				
No	0.67 (0.39 – 1.14)	0.146				0.60 (0.38 – 0.96)	**0.034**	0.60 (0.39 – 0.93)	**0.023**	-0.504	0.64 (0.40 – 1.02)	0.064			
Sex															
Male	reference					reference					reference				
Female	0.87 (0.51 – 1.48)	0.611				1.41 (0.90 – 2.22)	0.130				0.72 (0.45 – 1.13)	0.158			
Live accompanied															
Alone	reference					reference					reference				
Accompanied	0.81 (0.40 – 1.64)	0.563				0.78 (0.43 – 1.44)	0.443				0.57 (0.31 – 1.06)	0.078			
Education															
Bachelor or more	reference					reference					reference				
High school	0.52 (0.29 – 0.94)	**0.032**	0.50 (0.29 – 0.88)	0.017	-0.677	0.54 (0.32 – 0.91)	**0.020**	0.50 (0.31 – 0.82)	**0.006**	-0.683	0.83 (0.50 – 1.39)	0.491			
Less than high school	0.61 (0.25 – 1.48)	0.278				0.88 (0.39 – 1.97)	0.764				0.65 (0.27 – 1.54)	0.329			
Perceived mood															
Happy	reference		reference			reference		reference			reference		reference		

Sad	0.43 (0.22 – 0.85)	**0.016**	0.43 (0.24 – 0.77)	**0.005**	-0.840	0.49 (0.26 – 0.92)	**0.028**	0.50 (0.29 – 0.86)	**0.013**	-0.690	0.44 (0.22 – 0.87)	**0.019**	0.50 (0.27 – 0.91)	**0.025**	**-0.702**

Complete model: all the variables. Final model: just the significant variables. Bold: p<0.05

Abbreviations: CI: confidence interval; OR: odds ratio; PA: physical activity; SB: sedentary behavior.

4. Discussion

Complying with current physical activity recommendations can reduce the risk of mortality from cardiovascular diseases by 47% (Coelho-Ravagnani et al., 2021), as well as other numerous benefits to society. However, given the high values of inactivity in Portugal (*Desporto e atividade física - setembro 2022 - - Inquérito Eurobarómetro*, 2022), it is important to further understand, among those who comply with recommendations, the characteristics or correlates most associated with this behavior, given that the recommendations can be indicated as interchangeable. The present study found that 75.2% of the public park users in Oeiras – Portugal, met the overall physical activity guidelines from the WHO. These values are above those found in other recent international surveys and in a vast national investigation, the National Food, Nutrition, and Physical Activity Survey (IAN-AF, 2015–2016) (Teixeira et al., 2019), which found that only 27.1% of the Portuguese population complied with the recommendations.

One of the factors that may explain this difference is the fact that our sample consisted of potential regular users of the infrastructures for practicing physical activity, as they were approached in these places. In addition, the current public policies of the Municipality of Oeiras incentivize the practice of physical activity through the Municipal Plan for Development and Innovation in Sports and Physical Activity (2021-2030). This plan aims to promote physical activity for all, from conceptualization as a social activity in school and leisure contexts to the practice of competition and high performance. In addition, the various attributes of the local environment can also contribute to higher levels of physical activity because the municipal plan also contemplated the reformulation of green spaces and hiking trails and bike paths, as well as the installation of quality outdoor fitness equipment. In fact, walkability components, the provision of quality parks and playgrounds, and the installation of or improvements in active transport infrastructures have been shown to be positively associated with physical activity levels in previous studies (Smith et al., 2017), which may partly explain why users of these sites were more active than the rest of the Portuguese population. By itself, this result is of interest, as it shows that random people evaluated in these public park sites seem to be more active in comparison to the general population, thus representing a relevant finding that shows the impact that investing in the cities' environment can have on people's health habits. However, our sample was evaluated in a place where there is a tendency to find more active volunteers, since it considered public places for the practice of physical activity, thus preventing the generalization to other populations, that may not benefit from these types of infrastructures.

Furthermore, the aim of this study was not to assess the impact of these installations on the physical behavior of users, but instead to identify the correlates associated with the chance of compliance with physical activity recommendations by WHO, while differentiating the two main guidelines (i.e., moderate, or vigorous).

Regarding the main goal of the present investigation, our findings indicate that depending on the physical activity intensity, the correlates for the noncompliance to these guidelines can be different, with age and sedentary behavior being the most significant (emerging in all), but other common correlates found in previous studies (e.g., BMI, duration and quality of sleep, perceived well-being, sex, living in the municipality, financial status, living alone or accompanied, having or not having a chronic disease, or the usual way to commute), being non-significant.

To attain the overall physical activity guideline, age, having at least the high school level of education, and "looking sad" were the significant correlates. When looking specifically to the 150 min/week moderate guideline, age did not remain a significant factor, and sleep quality, educational level, sedentary behavior, and "looked sad" emerged as important correlates. Thus, compared to those that reported better sleep quality, the poor sleepers were less prone (b -0.504 [p=0.023]) to meet the moderate physical activity guideline, as well, compared with the graduated, the ones who only had high school level were less prone to be active (b -0.683 [p=0.006]), and compared with "looking happy", the ones "looking sad" in the moment of the interview, were less prone to meet the moderate intensity-based guideline (b -0.690 [p=0.025)]. Even more significantly, the participants who had high (≥420 min/day) and medium sedentary behavior (181–419 min/day), had less 1.75 and 0.939 times per minute of probability to meet the moderate physical activity recommendation, respectively (both, p<.001).

The chance of complying with the 75 min/week vigorous guideline was lower for older individuals (b -0.040 for life year [p<.001]), for those with high sedentary behavior (b -0.063 [p=0.027]), and the ones that "looked sad" in the interview (b -0.702 [p=0.025]), thus suggesting some differences in terms of correlates that are associated with attaining a specific physical activity guideline.

In our analyses, the older adults were more likely to comply with the moderate physical activity recommendation (51.9% complied) than the vigorous recommendation (26.5% complied). Previous European studies also indicate that age is a major factor in physical activity adherence (Nikitara et al., 2021), which can explain why it was negatively associated with attaining the vigorous guideline but not the moderate-related guideline. Older adults report functional limitations, lack of motivation, and not having a practice partner as important barriers to involvement in physical activity (Stathi et al., 2012). In addition, they usually report that factors such as the difficulty of access to group-oriented activities, the perception of discomfort and insecurity toward physical activity in the absence of professional instructions, the lack of adequate leisure activities, and the lack of transport to existing points as consistent barriers to the practice (Simmonds et al., 2016). Thus, it is possible that older adults achieve the amount of physical activity mainly through walking; therefore, we consider that it would be important for this age group to be contemplated within the current and future public projects to reduce their feelings of insecurity about vigorous physical activity, with specialized instructors and appropriated activities to their age group.

Being in the high sedentary behavior category was the most negative factor for compliance with overall, moderate, and vigorous physical activity guidelines, which means that even though sedentary behavior and physical activity are fairly independent behaviors, they can impact each other. Although, evidence indicates that sedentary behavior truly competes with low intensity physical activity and not with moderate and vigorous intensity.(Mansoubi et al., 2014) A good example of this are the results of a large database study with NHANES data from 2003-2004(von Rosen, 2023), where it was found that the percentage of the day required to comply with the WHO guidelines was 2.4% to 4.7% of the day. This means that if we exclude about 33.3% (8 hours/day) for sleep, we remain with 35.7% to 38% of the day, that can be spent in either low intensity physical activity or sedentary behavior. These are the two behaviors that truly compete with each other.

Since the prevalence of sedentary behavior has increased in recent years (López-Valenciano et al., 2020) and the harmful health impact associated with excessive accumulation it is necessary to create specific interventions to reduce this behavior in its most diverse domains, that is, at work, in transportation or in leisure time (Harvey et al., 2013; Mielke et al., 2014). Although the quality of evidence is low, previous reviews indicate that multicomponent interventions in work (i.e., warnings on posters to sit less, incentives for time breaks from sitting to standing, time control sitting by electronic devices, and standing workstations) are strategies that have been presented as more effective (Martin et al., 2015; Prince et al., 2014) and should be adopted and encouraged by health professionals and entities for all sedentary workers. In addition, when cities manage to become more attractive to physical activity, with more available leisure active spaces, such as the ones targeted in the current study, a shift from sedentary behavior to more physically active behavior is expected to happen.

Our data indicated that the amount of sleep (i.e., duration) was not associated with compliance with physical activity recommendations, but a dimension of sleep quality, continuous sleep (Buysse, 2014), was a relevant factor that was positively associated with complying to the moderate physical activity recommendation. Most likely, this is due to sleep being a set of many physiologic processes under primarily neurobiological regulation that impact many physiologic systems. Disturbances in sleep have been associated with several adverse health outcomes, such as mortality, obesity, diabetes, inflammation, cardiovascular disease, neurocognitive functioning, and mental health (Grandner, 2017). In addition, sleep must be restorative, allowing physical and mental well-being, attending to social demands, and sustained alertness during waking hours (Buysse, 2014); thus, discontinuing sleep can affect vitality or disposition to the practice of physical activity. Previous reviews reported the positive association of physical exercise with sleep quality in adults (Kredlow et al., 2015) and older adults (Vanderlinden et al., 2020); however, the majority of these studies were observational, not allowing to establish causality.

Although it is a subjective and an interpretative measure from the interviewers, and therefore, under the bias of the evaluator, we collected information about how the participants looked at the time of the interview, with only two options: "happy or sad" response. Interestingly, the participants who seemed happy at the time of the interview were the ones who were most likely to comply with all physical activity recommendations, irrespective of the specific recommendation, and this variable remained in all models as a significant factor. A systematic review of 28 studies comparing physical exercise between green spaces and indoor settings found that outdoor exercise was associated with affective valence and pleasure (Lahart et al., 2019), which may explain our perception of happiness in the participants. In another systematic review that included 11 studies with 833 adults, mostly young students, the results indicated that compared with exercising indoors, exercising in natural environments was associated with greater feelings of revitalization and positive engagement, decreased tension, confusion, anger and depression symptoms, and increased energy (Thompson Coon et al., 2011). However, both investigations reported low-quality studies; in addition, they evaluated physical exercise (not physical activity), which may overestimate the effects on mood in comparison with physical activity (e.g., exercise in gym versus walking) (Meyer et al., 2016; Schuch et al., 2018).

4.1.Limitations

Although our research provides new insights into the correlates that may hinder compliance with physical activity guidelines, the main limitations of our study are the cross-sectional nature of the data, which does not allow inferring causality, in addition to using questionnaire prone to recall, social desirability and bias in the perception of physical activity intensity by the interviewed subjects can result in an overestimation of physical activity or an underestimation of sedentary behavior. Another compromising point is the fact that our sample was evaluated in a place where there is a tendency to find more active volunteers, since it considered public places for the practice of physical activity, thus preventing the generalization to other populations. However, we must mention as a strength the fact that we considered a substantial number of older adults (20.6%), which reflects the reality of the country (23,4% in Censos 2021), in addition to the use of one of the main measurement instruments validated in the literature, such as the IPAQ.

4.2.Conclusions

Finally, our investigation indicates that the correlates for the fulfillment of physical activity recommendations may differ according to the targeted intensity of the recommendation itself. Our findings suggest that in addition to investing in the environmental context, in order to facilitate the practice of physical activity, targeting reductions on sedentary behavior, improving sleep quality, and promoting a higher educational level, may further reduce physical inactivity of the population, more specifically for a fraction of the population that is already more active than most of their peers.

The authors declare that there is no conflict of interest.

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Annex VI: Letter of acceptance for the poster presentation of the study 5.

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Cologne, 08.04.2024 - 15:56:26

Letter of Acceptance

This is to certify that the following title has been accepted at the 29th Annual Congress of the European College of Sport Science in Glasgow (Scotland, UK), 2-5 July 2024:

Sabrina Costa Teno

Universidade Lusófona de Humanidades e Tecnologias
Campo Grande 376
1749-024 Lisboa, Portugal

Abstr.-ID: 1007
Title: Longitudinal changes in sitting time and impact on wellbeing and quality-of-life of sedentary workers.
Authors: Costa Teno, S., Silva, M., Silva, H., Júdice, P., Institution: Universidade Lusófona de Humanidades e Tecnologias
Presentation format: Poster, YIA: No

European College of Sport Science

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