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The Role of Physical Activity in the Aging Process

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Aim of the Study:

This review aims to delve into the crucial role of physical activity in the aging process, focusing on its extensive benefits for maintaining health, preventing disease, and enhancing the overall quality of life in older adults. By synthesizing current knowledge, the study explores the multifaceted ways in which regular physical exercise can mitigate the physiological and psychological challenges associated with aging. The objective is to highlight the importance of physical activity not only as a tool for improving physical health but also as a means of fostering independence and promoting longevity in an aging population. Furthermore, this review seeks to underscore the pressing need for public health initiatives that encourage lifelong engagement in physical activity.

Materials and Methods:

A meticulous and thorough review of existing literature was carried out using prominent academic databases, including PubMed, Google Scholar, and Medline. The search focused on identifying relevant articles by employing targeted keywords such as "physical activity," "aging," "exercise benefits," "older adults," and "healthy aging." The selection criteria encompassed a wide range of studies, including clinical trials, observational studies, meta-analyses, and systematic reviews, to ensure a comprehensive understanding of the topic. The collected data was carefully analyzed to identify trends, recurring themes, and gaps in the current body of research, providing a robust foundation for discussing the role of physical activity in aging.

Results and Conclusions:

The findings demonstrate that physical activity is a cornerstone of healthy aging,

offering numerous benefits that extend beyond mere disease prevention. Regular exercise is shown to counteract age-related declines in cardiovascular health, bone density, muscle strength, and cognitive function, while also reducing systemic inflammation and oxidative stress. These physiological benefits translate into improved functional independence, a reduced risk of chronic conditions, and a higher quality of life for older adults. Additionally, adherence to physical activity guidelines has been associated with lower mortality rates and enhanced mental well-being. Despite these well-documented benefits, many older adults face barriers to regular exercise, including mobility limitations, chronic health issues, and a lack of accessible programs. Addressing these challenges through tailored interventions, community programs, and policy support is essential to fostering a culture of active aging. Future research should also explore innovative strategies to enhance participation and assess the long-term effects of physical activity on aging populations, emphasizing its potential to transform the aging experience.

Keywords: Physical activity, Aging, Older adults, Exercise benefits, Healthy aging

Abstract

Aging is associated with a decline in physiological and cellular functions, leading to increased susceptibility to various chronic diseases, including cardiovascular, musculoskeletal, and metabolic disorders. As life expectancy rises, so does the need for effective strategies to mitigate the health challenges faced by older adults. Physical activity has emerged as a critical intervention, offering a wide range of benefits that address the multifaceted impacts of aging. This review explores the role of regular physical activity in enhancing health, preventing disease, and improving the overall quality of life in older adults. It highlights how exercise mitigates age-related declines in muscle strength, bone density, and cardiovascular health, while also reducing systemic inflammation and oxidative stress. Furthermore, the integration of physical activity into daily routines is shown to lower the risk of chronic conditions, improve cognitive function, and promote functional independence. Despite its benefits, barriers such as mobility issues, chronic illnesses, and limited accessibility to exercise programs hinder widespread adoption among aging populations. This review underscores the importance of tailored and accessible exercise interventions, as well as the need for further research to optimize physical activity guidelines and strategies. By prioritizing physical

activity, society can empower older adults to lead healthier, more independent lives, ultimately transforming the aging process.

1. Introduction

Aging is characterized by decreased tissue and cellular functions and increased susceptibility to diseases including neurodegenerative, cardiovascular, metabolic, musculoskeletal, and immune-related diseases [1]. With increased life expectancy comes an increased risk of disease in older adults, however following the global recommendations for physical activity may ameliorate these challenges [2]. Today, around 10% of the world population is aged 60 years and over, and this percentage is expected to approximate 20% by 2050 [3]. Diseases resulting from inactivity present drastic and far-fetching health risks at all stages of life [4]. Data such as these have sparked interest in physical activity for older adults and this review aims to consider how physical activity may play a role in the aging process and its effect on health, disease prevention, and overall quality of life in older adults. This review highlights the centrality of physical activity in addressing the challenges of aging by exploring the physiological and psychological advantages of routine practice of physical exercise.

2. Aging and Key Physiological Changes

The decline seen in both men and women was identified by the researchers as one of the greatest contributors to the decline in physical activity and functional fitness with aging. The results also highlighted that aging is responsible for multiple physiological changes affecting body fat, muscle strength, flexibility, agility, and endurance in upper and lower limbs [5]. The performance deficits seen in mid to later life are due to inactivity, rather than the aging process per se [6]. Age-induced impairment of endothelium-dependent relaxation is mediated by reduced nitric oxide (NO) bioavailability secondary to oxidative stress, excess of

reactive oxygen species, and insufficient scavenger systems. The rest are related to high levels of endothelin-1 (ET-1), vascular inflammation, Advanced glycation end products (AGEs), endothelial apoptosis, and lack of estrogen receptor α in postmenopausal women [7]. A sedentary lifestyle triggers chronic cardiovascular dysfunction, weakening the body's capacity to adapt to challenges and diminishing physiological reserves. This increases the risk of acute events such as strokes and heart attacks, hastening the aging process, promoting frailty, and significantly reducing the span of healthy living [8].

The oxidative stress theory of aging proposes that aging is driven by cumulative damage caused by reactive oxygen and nitrogen species (RONS). It is considered an important contributor to the development of age-related diseases, like cardiovascular disease, renal disease, neurodegeneration, cancer, sarcopenia, and frailty [9]. Aging is characterized by persistent, low-grade inflammation, and older adults show much higher levels of inflammatory markers such as interleukin (IL)-6 and tumor necrotizing factor-alpha (TNF-α), and acute-phase proteins, including C-reactive protein (CRP), a well-known marker of systemic inflammation, and serum amyloid A (SAA), which is part of the body’s response to infection and tissue injury, in the absence of disease [10]. With the aging process, the influx of macrophages in the fat tissue affects the preadipocytes, which reduces the formation of fat and increases lipotoxicity and the generation of stress pathways. This review examines the role these processes play in fat redistribution and metabolic disturbances in aging [11]. Also sarcopenia, a common health problem in older adults, is described as the age-related loss of muscle mass, strength and physical function. Exercise training has proven to be one of the most powerful protective influences against this aging-related condition [12]. It is known that the aging process plays an important role in the loss of muscle mass and strength. According to researchers, muscle strength decreased by 16.6% to 40.9% when comparing individuals under 40 years of age with those over 40 [13].

With aging, bone homeostasis is disrupted, leading to an imbalance between formation and resorption. This dysfunction is a result of oxidative stress, DNA damage, and cellular senescence, with a consequent decline in bone integrity [14]. Osteoporotic fractures result in long-term disability, reduced quality of life, higher mortality, and significant economic and medical resource costs [15].

Also, the locations of fat tissue change over the life cycle, from under the skin to (vis-ceral) and ectopic (in bone marrow, muscle, and liver) deposits, with these trends becoming accentuated during old age and increasing metabolic syndrome risk [16].

3. Benefits of Physical Activity in Aging

Physical inactivity is a powerful driver of decreased life expectancy and acceleration in the aging of the most important physiological functions. Nevertheless, this early aging of the body may be prevented by lifelong physical activity [17]. Physical activity is necessary to ameliorate key aging processes (even at old ages) such as chronic inflammation, mitochondrial function and autophagy. It is also involved in the regulation of oxidative stress, increases the release of myokines and modulates insulin-like growth factor signaling [18]. Coronary heart disease, strokes, type 2 diabetes and many cancers, among them breast and colon, are some of the many ailments that regular moderate physical activity protects against in older adults. It also decreases all-cause mortality, enhances lipid profiles, and lowers fat mass and blood pressure. In addition, it improves bone density, decreases the incidence of falls and supports better health in old age [19]. According to a study, adults who adhere to the 2023 Physical Activity Guidelines for Americans, who regularly do the suggested volumes of aerobic and muscle-strengthening pursuits, have a much lower risk of all-cause and cause-specific mortality [20]. Other research also indicates that active lifestyles protect against longevity and the pace of aging — partially due to their lipid effects [21]. Regular aerobic activity can help reduce the risk of future disability and functional limitations among older adults, according to any exercise programs of short-term duration. There is some evidence that to obtain meaningful benefits this activity needs to be of at least moderate intensity, with higher levels providing even greater benefit [22]. In older adults, one meta-analysis found that resistance exercises boost lean body mass by about 1 kg. This is more effective when done with higher training volumes and started at a younger age, highlighting the importance of getting involved early [23].

Exercise benefits brain health, in part, by improving capillary functions, increasing oxygen supply, and supporting metabolism of neurons. It also buffers stress resistance and increases neurotrophin levels. Regular physical activity in adult years greatly lowers the risk

of mild cognitive impairment and Alzheimer's disease [24]. The mental health impacts are similarly clear, and physical activity occupies a central role in decreasing the risk of depression [25]. While programs to improve the fitness, flexibility, and balance of older adults are an asset, adding cognitive strain to exercise is better. Exercise promotes brain health and cognitive functioning related to senescence, as it promotes neuroplasticity and strengthens mental resilience [26].

Aging immune systems: Older adults do emerge from exercise with active T lymphocytes and NK cells, but training regimens don't substantially reverse immune aging, a study found. Older adults who are well conditioned show better immune function, but it is unknown whether this is an effect of exercise or other lifestyle choices [27].

4. Recommended Types of Physical Activity for Older Adults

Regular exercises may play a role in safeguarding the decline in mobility as well as physical activity associated with old age. [28] For most patients, more active than their current routine will serve them well. They should be advised to gradually increase their activity, for example, walking progression by weeks or increasing the number of stairs climbed in a day [29]. Older adults should include aerobic, strength, flexibility and balance exercises in their routines — and balance training is key for older adults at risk of falls or mobility issues. Exercise therapy for persons with chronic diseases or with limited abilities should be initiated at low intensity and gradually increased, ensuring both tolerance and preference [30]. Prevention of injuries is dependent on structured training programs that utilise safe and familiar sports equipment, go through warm-up and cool-down routines, and multiphasic training [31]. In older adults, resistance exercise sessions, irrespective of intensity, were accompanied by increased aerobic capacity and treadmill performance [32]. This suggests that improvements in strength may enhance aerobic capacity in older adults. Training on cognitive and physical exercises combined are effective to enhance executive function in older adults. Such interventions can be crucial in minimizing the high prevalence of cognitive decline in this age group, leading to improved autonomy and consequently a considerable gain in the quality of life [33]. One study showed that older adults without chronic conditions were more likely to meet physical activity guidelines (30%) than they were to have chronic diseases (23%). Higher education, income, and moderate alcohol use were facilitators of activity levels while pain, mobility

issues, and low BMI were contributory barriers. Popular physical activities involved walking, gardening and home exercises [34].

5. Challenges and Strategies in Promoting Physical Activity

Health care providers and systems can assist older adults in enhancing or preserving their physical activity levels as they age by providing comprehensive recommendations and individualized support. This information, as well as any other resources people can obtain, need to be trusted as accurate for safe and appropriate physical activity participation during later life [35]. Key components of exercise interventions to motivate older adults are to make the activities affordable, tailored to age and physical capability, include in-person support with additional resources, and strategies that promote behavior change [36]. Physicians should actively encourage exercise behavior through consistent, concise, and localizing information so that they can optimally help perform their critical function of promoting health and extending life [37]. Physical activity and older adults, especially with dementia, are a subject for which much can be done by physiotherapists. They enable people to be active, encouraging independence and maximizing the positive impacts of regular exercise through tailored exercise plans and supported structured exercise [38]. Interventions such as group physical activity programs for older adults should focus on fostering social bonding so that participants can enjoy supportive care by being embedded in social bonds [39].

The increasing access to technology opens up a massive opportunity to help fulfill the health needs of over 50s people — in fact — retirees. Health solutions with combinations of digital tools and in-person support that integrate behavior change strategies for undergoing lifestyle modifications can substantially improve long-term health outcomes and facilitate lasting changes in well-being [40]. Exercise programs that are based on technology have been successful at keeping older adults engaged, which offers a viable strategy for promoting physical activity and preventing falls. Participants tend to enjoy using these tools which contributes primarily to their high adherence rates [41]. A study found that accelerometer use, alone or in combination with other interventions, significantly increased physical activity levels among older adults. In contrast, pedometers were not shown to have the same effect

[42]. To enhance the quality of life as individuals age, it is crucial to invest fully in programs that promote physical activity. These initiatives not only contribute to better physical health but also lead to improvements in participants' mental well-being, while simultaneously lowering their risk of developing various illnesses [43].

6. Barriers to Physical Activity in Older Adults and Strategies to Overcome Them

Some seniors still think that it’s not necessary to exercise or may even be harmful to their health. Others know of its benefits however face a range of barriers to participation, which are often prohibitive [44]. Study findings identified barriers to older adults remaining active as poor health (57.7%), loneliness or lack of companionship (43.0%) and no interest in physical activity (36.7%) as the most commonly cited. This is particularly interesting, since the researchers also found that women were more than men to name obstacles such as limited access to sports or leisure activities (30.3% vs 15.6%) and lack of transport (29.0% vs 7.1%) [45]. Unfortunately, despite the many benefits of physical activity, many medical, psychological, social, and environmental barriers create substantial roadblocks to participation. By implementing strategies to understand barriers and facilitators to physical activity, rehabilitation professionals can play a critical role in facilitating this behaviour change for their clients, which in turn may have a significant impact on their quality of life [46]. And neighborhood policies and design of the built environment can either facilitate or inhibit activities of these midlife and older adults with mobility limitations in their communities. To promote active and healthy aging, it is critical to adjust neighborhood environments for people who depend on assistive devices to ensure independence and well-being [47].

Having supportive environments and addressing barriers to physical activity are essential for getting older adults to move more. By acknowledging barriers, like negative health outcomes, lack of access or inclusivity within the built environment to be more inclusive, we can help more individuals enjoy the numerous benefits of physical activity. Rehabilitation professionals, urban planners, and communities must work together to foster an environment that promotes active aging and enhances the overall quality of life for older adults.

7. Conclusions

Exercise constitutes one of the best pillars of healthy aging because it provides extensive benefits reflective of the physiological, psychological, and functional challenges that accompany aging. As outlined in this review, exercise programs can counteract age-related decline in muscle strength, cardiovascular health, bone density, and cognition and lower inflammation and oxidative stress. All these positive outcomes lead to increased functional independence, decreased risk of chronic diseases and better quality of life among older adults. However, while it is an established panacea there is still much to learn about how physical activity can be tailored to the diverse needs of our aging populations. Older people also often have some challenges that are unique to them, including several chronic conditions, mobility limitations and different levels of fitness. Beyond specific health conditions, we currently lack data to determine which exercise regimens are best suited for people who have coexisting health conditions like cardiovascular disease, diabetes, arthritis or cognitive function. Learning how to individualize exercise based on intensity, duration, and type for these populations will be key to maximizing the benefits of these interventions and minimizing the risks.

Future research should also examine long-term effects of such individualized interventions on physical and mental health outcomes.

Investigation into the interplay between exercise and other treatment modalities — pharmacological and dietary regimes — may be more appropriate general strategies to combat disease processes in the elderly. In addition, there remains an urgent need for research which focuses on obstacles to participation in exercise, for those who might not have access to resources or support. Healthcare providers and community leaders are indexed key players to pave the way to facilitate older adults to be physically active in a safe, effective, and accessible manner. Examples include building programs that are mindful of differing abilities and health statuses, incorporating physical activity into normal clinical care for older populations, and employing technology to implement individualized and adaptive exercise interventions.

Overall, the increased body of evidence should continue to explore the importance of physical exercise on factors that contribute to healthy aging, whilst opening avenues for innovation to enhance our understanding further. And if we prioritize investigating such customized exercise programming for older people with chronic illness components and

embed such strategies into population level public health initiatives, we can help people live better, more independent lives. When it comes to aging, physical activity may rewrite the book — transforming this phase from inevitable decline to opportunity for continued vitality and resilience.

Author Contributions

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REFERENCES:

1. Guo J, Huang X, Dou L, Yan M, Shen T, Tang W, Li J. Aging and aging-related diseases: from molecular mechanisms to interventions and treatments. Signal Transduction and Targeted Therapy. 2022 Dec 16;7(1):391.

2. Levinger P, Hill KD. Are the recommended physical activity guidelines practical and realistic for older people with complex medical issues?. Journal of Geriatric Physical Therapy. 2021 Jan 1;44(1):2-8.

3. Sixsmith A. Technology and the challenge of aging. InTechnologies for active aging 2013 Mar 26 (pp. 7-25). Boston, MA: Springer US.

4. Harridge SD, Lazarus NR. Physical activity, aging, and physiological function. Physiology. 2017 Mar;32(2):152-61.

5. Milanović Z, Pantelić S, Trajković N, Sporiš G, Kostić R, James N. Age-related decrease in physical activity and functional fitness among elderly men and women. Clinical interventions in aging. 2013 May 21;8:549.

6. Leyk D, Rüther T, Wunderlich M, Sievert A, Eßfeld D, Witzki A, Erley O, Küchmeister G, Piekarski C, Löllgen H. Physical performance in middle age and old age: good news for our sedentary and aging society. Deutsches Ärzteblatt International. 2010 Nov;107(46):809.

7. Seals DR, Jablonski KL, Donato AJ. Aging and vascular endothelial function in humans. Clinical science. 2011 May 1;120(9):357-75.

8. Charansonney OL. Physical activity and aging: a life-long story. Discovery medicine. 2011 Sep 9;12(64):177-85.

9. Liguori I, Russo G, Curcio F, Bulli G, Aran L, Della-Morte D, Gargiulo G, Testa G, Cacciatore F, Bonaduce D, Abete P. Oxidative stress, aging, and diseases. Clinical interventions in aging. 2018 Apr 26:757-72.

10. Brüünsgaard H, Pedersen BK. Age-related inflammatory cytokines and disease. Immunology and Allergy Clinics. 2003 Feb 1;23(1):15-39.

11. Sepe A, Tchkonia T, Thomou T, Zamboni M, Kirkland JL. Aging and regional differences in fat cell progenitors–a mini-review. Gerontology. 2010 Jan 29;57(1):66-75.
12. Perracini MR, Franco MR, Ricci NA, Blake C. Physical activity in older people–Case studies of how to make change happen. Best Practice & Research Clinical Rheumatology. 2017 Apr 1;31(2):260-74.
13. Keller K, Engelhardt M. Strength and muscle mass loss with aging process. Age and strength loss. Muscles, ligaments and tendons journal. 2014 Feb 24;3(4):346.
14. Chandra A, Rajawat J. Skeletal aging and osteoporosis: mechanisms and therapeutics. International journal of molecular sciences. 2021 Mar 29;22(7):3553.
15. Sözen T, Özışık L, Başaran NÇ. An overview and management of osteoporosis. European journal of rheumatology. 2017 Mar;4(1):46.
16. Sepe A, Tchkonia T, Thomou T, Zamboni M, Kirkland JL. Aging and regional differences in fat cell progenitors–a mini-review. Gerontology. 2010 Jan 29;57(1):66-75.
17. Booth FW, Laye MJ, Roberts MD. Lifetime sedentary living accelerates some aspects of secondary aging. Journal of applied physiology. 2011 Nov;111(5):1497-504.
18. Izquierdo M, Merchant RA, Morley JE, Anker SD, Aprahamian I, Arai H, Aubertin-Leheudre M, Bernabei R, Cadore EL, Cesari M, Chen LK. International exercise recommendations in older adults (ICFSR): expert consensus guidelines. The journal of nutrition, health & aging. 2021 Jul;25(7):824-53.
19. Vogel T, Brechat PH, Leprêtre PM, Kaltenbach G, Berthel M, Lonsdorfer J. Health benefits of physical activity in older patients: a review. International journal of clinical practice. 2009 Feb;63(2):303-20.
20. Zhao M, Veeranki SP, Magnussen CG, Xi B. Recommended physical activity and all cause and cause specific mortality in US adults: prospective cohort study. Bmj. 2020 Jul 1;370.
21. Lu TY, Wang J, Jiang CQ, Jin YL, Cheng KK, Lam TH, Zhang WS, Xu L. Active longevity and aging: dissecting the impacts of physical and sedentary behaviors on longevity and age acceleration. GeroScience. 2024 Sep 4:1-4.
22. Paterson DH, Warburton DE. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. International Journal of Behavioral Nutrition and Physical Activity. 2010 Dec;7:1-22.

23.Peterson MD, Sen A, Gordon PM. Influence of resistance exercise on lean body mass in aging adults: a meta-analysis. Medicine and science in sports and exercise. 2011 Feb;43(2):249.

24. Buchner DM. Physical activity and prevention of cardiovascular disease in older adults. Clinics in geriatric medicine. 2009 Nov 1;25(4):661-75.

25. Kaliman P, Párrizas M, Lalanza JF, Camins A, Escorihuela RM, Pallas M. Neurophysiological and epigenetic effects of physical exercise on the aging process. Ageing research reviews. 2011 Sep 1;10(4):475-86.

26. Gheysen F, Poppe L, DeSmet A, Swinnen S, Cardon G, De Bourdeaudhuij I, Chastin S, Fias W. Physical activity to improve cognition in older adults: can physical activity programs enriched with cognitive challenges enhance the effects? A systematic review and meta-analysis. International Journal of Behavioral Nutrition and Physical Activity. 2018 Dec;15:1-3.

27. Bruunsgaard H, Pedersen BK. Effects of exercise on the immune system in the elderly population. Immunology and Cell Biology. 2000 Oct;78(5):523-31.

28. Westerterp KR, Meijer EP. Physical activity and parameters of aging: a physiological perspective. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2001 Oct 1;56(suppl_2):7-12.

29. Nied RJ, Franklin B. Promoting and prescribing exercise for the elderly. American family physician. 2002 Feb 1;65(3):419-27.

30. Chodzko-Zajko W, Schwingel A, Park CH. Successful aging: the role of physical activity. American journal of lifestyle medicine. 2009 Jan;3(1):20-8.

31. Kallinen M, Markku A. Aging, physical activity and sports injuries: an overview of common sports injuries in the elderly. Sports Medicine. 1995 Jul;20:41-52.

32. Vincent KR, Braith RW, Feldman RA, Kallas HE, Lowenthal DT. Improved cardiorespiratory endurance following 6 months of resistance exercise in elderly men and women. Archives of Internal Medicine. 2002 Mar 25;162(6):673-8.

33. Eggenberger P, Schumacher V, Angst M, Theill N, de Bruin ED. Does multicomponent physical exercise with simultaneous cognitive training boost cognitive performance in older adults? A 6-month randomized controlled trial with a 1-year follow-up. Clinical interventions in aging. 2015 Aug 17:1335-49.

34. Ashe MC, Miller WC, Eng JJ, Noreau L. Older adults, chronic disease and leisure-time physical activity. Gerontology. 2009 Jun 20;55(1):64-72.

35. Bethancourt HJ, Rosenberg DE, Beatty T, Arterburn DE. Barriers to and facilitators of physical activity program use among older adults. Clinical medicine & research. 2014 Sep 1;12(1-2):10-20.
36. Arnautovska U, O'CALLAGHAN FR, Hamilton K. Behaviour change techniques to facilitate physical activity in older adults: what and how. Ageing & Society. 2018 Dec;38(12):2590-616.
37. Taylor D. Physical activity is medicine for older adults. Postgraduate medical journal. 2014 Jan;90(1059):26-32.
38. Yokogawa M, Taniguchi Y, Yoneda Y. Qualitative research concerning physiotherapy approaches to encourage physical activity in older adults with dementia. Plos one. 2023 Jul 27;18(7):e0289290.
39. Zimmer C, McDonough MH, Hewson J, Toohey AM, Din C, Crocker PR, Bennett EV. Social support among older adults in group physical activity programs. Journal of Applied Sport Psychology. 2023 Oct 2;35(4):658-79.
40. Schoufour JD, Tieland M, Barazzoni R, Ben Allouch S, Bie JV, Boirie Y, Cruz-Jentoft AJ, Eglseer D, Topinková E, Visser B, Voortman T. The relevance of diet, physical activity, exercise, and persuasive technology in the prevention and treatment of sarcopenic obesity in older adults. Frontiers in nutrition. 2021 May 24;8:661449.
41. Valenzuela T, Okubo Y, Woodbury A, Lord SR, Delbaere K. Adherence to technology-based exercise programs in older adults: a systematic review. Journal of Geriatric Physical Therapy. 2018 Jan 1;41(1):49-61.
42. Cooper C, Gross A, Brinkman C, Pope R, Allen K, Hastings S, Bogen BE, Goode AP. The impact of wearable motion sensing technology on physical activity in older adults. Experimental gerontology. 2018 Oct 2;112:9-19.
43. Cabo CA, Hernández-Beltrán V, Gamonales JM, Parraca JA, Fernandes O, Espada MC. Evolution of research related to how a sedentary lifestyle influences the aging process: a bibliometric review. Journal of Public Health. 2024 Jul 30:1-9.
44. Franco MR, Tong A, Howard K, Sherrington C, Ferreira PH, Pinto RZ, Ferreira ML. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. British journal of sports medicine. 2015 Oct 1;49(19):1268-76.

45. Moschny A, Platen P, Klaaßen-Mielke R, Trampisch U, Hinrichs T. Barriers to physical activity in older adults in Germany: a cross-sectional study. International Journal of Behavioral Nutrition and Physical Activity. 2011 Dec;8:1-0.
46. Martin JJ. Benefits and barriers to physical activity for individuals with disabilities: a social-relational model of disability perspective. Disability and rehabilitation. 2013 Dec 1;35(24):2030-7.
47. Rosenberg DE, Huang DL, Simonovich SD, Belza B. Outdoor built environment barriers and facilitators to activity among midlife and older adults with mobility disabilities. The Gerontologist. 2013 Apr 1;53(2):268-79