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SHORT REVIEW

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Beyond Exercise: The Cardiovascular Implications of Sedentary Lifestyles in the Modern Era

Qamil Dika*, Aldo Shpuza

Department of Public Health, University of Medicine, Tirana, Albania

Abstract

This short review explores the cardiovascular implications of modern sedentary lifestyles, emphasizing the distinction between physical inactivity and sedentary behavior (SB). This paper highlights how modern screen-based activities have replaced traditional sedentary lifestyles. Using a top-down approach (i.e., a biopsychosocial model), it discusses how psychosocial factors such as stress, technology use, and socioeconomic status lead to SB, harmful physiological changes, and, as a result, an increased risk of cardiovascular disease (CVD). Finally, different physical activity behaviors and levels impact CVD risk differently, revealing nuanced differences and emphasizing the need for clear definitions, measurement methods, and the identification of indirect determinants such as work and recreational infrastructure.**(International Journal of Biomedicine. 2024;14(3):398-400.)**

Keywords: sedentary behavior • physical inactivity • cardiovascular disease

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Introduction

There is a cacophony of terms between what is called physical inactivity and sedentary lifestyle, which complicates their interchangeability without being mutually exclusive categories: though one can be physically inactive but not sedentary, and vice versa, as physical activity and sedentary behavior (SB) are not opposites—individuals can meet physical activity recommendations for their age while also spending significant time in SB, exemplified by tertiary employees who often spend considerable time seated at work but may still engage in enough physical activity outside of work to meet health guidelines.[1,2] In quantitative terms, this comparison can be translated as follows: Physical inactivity is defined as the inability to meet recommended guidelines for physical activity, such as those provided by the World Health Organization, which suggest that, for example, adults aged 18-64 should engage in at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity (e.g., brisk walking or cycling), while SB is any waking behavior characterized by an energy expenditure of ≤1.5 metabolic equivalents while in a sitting, reclining, or lying posture.[3,4] It is often unclear whether the association between lack of physical activity and cardiovascular disease (CVD) is attributed to lack of exercise, physical inactivity, or SB. All this emphasis beyond exercise is due to the modern SB being significantly different from past eras, and the difficulty in establishing an operational definition directly impacts this relationship with cardiovascular health. Traditional SBs (watching television, reading books, and sitting for long periods at office jobs) are now being replaced by ultramodern screen-based activities, such as satellite television, high-speed internet entertainment, computers, and video games, using smartphones and tablets, as well as engaging with virtual reality devices and participating in virtual simulations. This shift has its contextual impact, which derives the purpose of our article.

Impact of Different Physical Activity Behaviors and Levels on CVD risk

Cardiovascular diseases (CVDs), a group of disorders of the heart and blood vessels, are the leading cause of death globally. The most common cardiovascular diseases are coronary heart disease, cerebrovascular disease, hypertension, peripheral arterial disease, rheumatic heart disease, heart arrhythmias, congenital heart disease, deep vein thrombosis, and pulmonary embolism.[5] The latest systematic review of 19 studies with 1,473,354 individuals over 13,559,139 person-years found that high SB increases CVD risk by 30%, and each additional sedentary hour raises the risk by 5%.[6] Another meta-analysis showed that physical inactivity was consistently associated with a 24% increased risk of coronary heart disease.[7] The nuanced difference between the impacts of SB

and physical inactivity on CVD risk may imply that the mere absence of movement, a characteristic of SB, could be more harmful than not meeting physical activity guidelines.

Another meta-analysis by Li and Siegrist[8] found that high levels of leisure time physical activity among men reduced the risk of overall CVD by 24%. In comparison, moderate levels of occupational physical activity reduced the risk by 11% in men and 17% in women. For this difference, it is crucial to investigate where we spend most of our time in SB, whether at work, during leisure, at home, etc. For example, individuals who predominantly engaged in SB at work exhibited a 34% higher risk of CVD compared with those who were more physically active during work hours.[9] Similarly, participants who spent more than six hours per day seated during leisure time had a 26% higher risk of CVD than those who spent less than three hours seated during leisure time.[10] In this context, it is understandable that the gaps often observed in the relative risk differences for CVDs due to physical inactivity or SB need to be increasingly well-defined. Therefore, the focus of scientific research should not only be on establishing the most operational and measurable definitions of these concepts of physical inactivity but also on identifying the distal determinants that indirectly influence the risk of CVDs. These determinants include factors such as the infrastructure of work environments and sports facilities, promoting and encouraging physical activity among individuals, and the broader socio-environmental factors that facilitate or hinder regular physical activity.

Understanding and Addressing the Burden of SB

According to a meta-analysis by Silveira et al.,[11] the overall prevalence of SB was 31%, while physical inactivity was higher at 43%. However, studies in different countries report varying rates, considering demographic, geo-locational, and socioeconomic factors that impact the prevalence of these behaviors.[12-14] Regarding public health, it is crucial to explore the factors behind these disparities, as the attributable impact on the population depends not only on the relative risk but also on the prevalence of exposure to SB within the population. In a systematic review study, the Population Attributable Fraction estimate for total fatal and non-fatal cardiovascular events due to not expending at least 550 kcal/week through physical activity is 8.5% (1.7%–16.7%), meaning that 8.5% of such events could potentially be prevented if everyone met this physical activity threshold.[15] Having understood the impact of these risk factors for CVDs, especially in recent years with updated literature, and reviewed the gaps in concepts, prevalence, and reported risk and impact magnitudes, we must now focus on deconstructing SB, understanding why it carries this burden, and exploring how it can be addressed in these modern times. In a critical review of systematic reviews on the determinants of SB, identified issues included geographical limitations (studies predominantly conducted in Europe and the United States), reliance on self-reported data, lack of qualitative research, limited focus on overall SB versus specific screen time, and insufficient determinant research focused on adults and elderly populations.[16] Methodological approaches in this context represent a crucial step in improving and unifying the methodology when measuring and assessing the relationship between SB and CVDs. Methodologies for measuring SB can be categorized into objective methods (direct observation and device-based, including research-based and commercial devices like accelerometers and wearables) and subjective methods (self-report questionnaires and logs/diaries, including ecological momentary assessment), with a trade-off between sample size and cost: objective methods tend to have smaller samples and higher costs, while subjective methods enable larger samples at lower costs.[17] Research also indicates that decreased physical activity, primarily due to a sedentary lifestyle, is significantly influenced by increased technology use, reliance on transportation, easy access to televisions and mobile phones, widespread internet use, stress, smartphone usage, advanced age (65+), chronic illnesses like hypertension, living environment, financial status, smoking habits, and ownership of computers and motor vehicles.[18-21] The advancement of digital infrastructure and widespread ownership of electronic devices is associated with increased daily sitting time (over 4.5 hours) among the general population, regardless of gender, highlighting the urgent need for public health strategies to counteract the SB promoted by modern technology.[22] Our current use of technology for leisure perpetuates physical inactivity. Yet, the growing trend of integrating exercise into technology or gamifying it presents an innovative and promising solution to this urgent public health issue, which we believe could effectively motivate individuals to be more active.[23] Physiological responses to behaviors vary along a continuum, changing linearly or nonlinearly, emerging after certain thresholds, or showing no change, leading to the distinct field of "sedentary physiology," which differs from exercise physiology.[24] Finally, the bio-psycho-social model elucidates how psychosocial factors—such as stress, the use of technology, and socioeconomic status—influence SB, such as reduced physical activity and prolonged sitting. These SBs lead to physiological changes in the body, such as altered metabolism and cardiovascular function, subsequently increasing the CVD risk.

In conclusion, modern sedentary lifestyles, heavily influenced by screen-based activities, contribute significantly to increased CVD risks through the interaction of psychosocial factors and harmful physiological changes. Clear definitions, improved measurement methods for physical inactivity and SB, and identifying indirect determinants such as work and recreational infrastructure are crucial for developing effective public health strategies to mitigate these risks.

Competing Interests

The authors declare that they have no competing interests.

References

1. Genin PM, Degoutte F, Finaud J, Pereira B, Thivel D, Duclos M. Effect of a 5-Month Worksite Physical Activity Program on Tertiary Employees Overall Health and Fitness. J Occup Environ Med. 2017 Feb;59(2):e3-e10. doi: 10.1097/JOM.0000000000000945. PMID: 28166129.

2. Thivel D, Tremblay A, Genin PM, Panahi S, Rivière D, Duclos M. Physical Activity, Inactivity, and Sedentary Behaviors: Definitions and Implications in Occupational

Health. Front Public Health. 2018 Oct 5;6:288. doi: 10.3389/fpubh.2018.00288. PMID: 30345266; PMCID: PMC6182813.
3. SBRN Terminology Consensus Project [Internet]. The Sedentary Behaviour Research Network (SBRN). [cited 2024 Jun 17]. Available from: https://www.sedentarybehaviour.org/sbrn-terminology-consensus-project/
4. WHO guidelines on physical activity and sedentary behaviour [Internet]. [cited 2024 Jun 17]. Available from: https://www.who.int/publications/i/item/9789240015128
5. Cardiovascular diseases (CVDs) [Internet]. [cited 2024 Jun 17]. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)
6. Onagbiye S, Guddemi A, Baruwa OJ, Alberti F, Odone A, Ricci H, Gaeta M, Schmid D, Ricci C. Association of sedentary time with risk of cardiovascular diseases and cardiovascular mortality: A systematic review and meta-analysis of prospective cohort studies. Prev Med. 2024 Feb;179:107812. doi: 10.1016/j.ypmed.2023.107812. Epub 2023 Dec 9.
7. Kivimäki M, Singh-Manoux A, Pentti J, Sabia S, Nyberg ST, Alfredsson L, Goldberg M, Knutsson A, Koskenvuo M, Koskinen A, Kouvonen A, Nordin M, Oksanen T, Strandberg T, Suominen SB, Theorell T, Vahtera J, Väänänen A, Virtanen M, Westerholm P, Westerlund H, Zins M, Seshadri S, Batty GD, Sipilä PN, Shipley MJ, Lindbohm JV, Ferrie JE, Jokela M; IPD-Work consortium. Physical inactivity, cardiometabolic disease, and risk of dementia: an individual-participant meta-analysis. BMJ. 2019 Apr 17;365:l1495. doi: 10.1136/bmj.l1495. PMID: 30995986; PMCID: PMC6468884.
8. Li J, Siegrist J. Physical activity and risk of cardiovascular disease--a meta-analysis of prospective cohort studies. Int J Environ Res Public Health. 2012 Feb;9(2):391-407. doi: 10.3390/ijerph9020391. Epub 2012 Jan 26. PMID: 22470299; PMCID: PMC3315253.
9. Gao W, Sanna M, Chen YH, Tsai MK, Wen CP. Occupational Sitting Time, Leisure Physical Activity, and All-Cause and Cardiovascular Disease Mortality. JAMA Netw Open. 2024 Jan 2;7(1):e2350680. doi: 10.1001/jamanetworkopen.2023.50680. Erratum in: JAMA Netw Open. 2024 Feb 5;7(2):e242037. doi: 10.1001/jamanetworkopen.2024.2037. PMID: 38241049; PMCID: PMC10799265.
10. Jingjie W, Yang L, Jing Y, Ran L, Yiqing X, Zhou N. Sedentary time and its association with risk of cardiovascular diseases in adults: an updated systematic review and meta-analysis of observational studies. BMC Public Health. 2022 Feb 12;22(1):286. doi: 10.1186/s12889-022-12728-6. PMID: 35148747; PMCID: PMC8840786.
11. Silveira EA, Mendonça CR, Delpino FM, Elias Souza GV, Pereira de Souza Rosa L, de Oliveira C, Noll M. Sedentary behavior, physical inactivity, abdominal obesity and obesity in adults and older adults: A systematic review and meta-analysis. Clin Nutr ESPEN. 2022 Aug;50:63-73. doi: 10.1016/j.clnesp.2022.06.001. Epub 2022 Jun 14. PMID: 35871953.
12. Van Dyke ME, Chen TJ, Nakayama JY, Moore LV, Whitfield GP. Changes in Physical Inactivity Among US Adults Overall and by Sociodemographic Characteristics, Behavioral Risk Factor Surveillance System, 2020 Versus 2018. Prev Chronic Dis. 2023 Jul 27;20:E65. doi: 10.5888/pcd20.230012. PMID: 37503944; PMCID: PMC10431925.
13. Shpuza A, Xhetani X. Prevalence and socio-demographic factors associated with physical inactivity among primary health care users in Tirana, Albania: A cross-sectional study. Journal of Health Sciences. 2021 Dec 30;11(3):186–90.
14. Nikitara K, Odani S, Demenagas N, Rachiotis G, Symvoulakis E, Vardavas C. Prevalence and correlates of physical inactivity in adults across 28 European countries. Eur J Public Health. 2021 Oct 11;31(4):840-845. doi: 10.1093/eurpub/ckab067. PMID: 34000007; PMCID: PMC8504996.
15. Al Tunaiji H, Davis JC, Mansournia MA, Khan KM. Population attributable fraction of leading non-communicable cardiovascular diseases due to leisure-time physical inactivity: a systematic review. BMJ Open Sport Exerc Med. 2019 Apr 9;5(1):e000512. doi: 10.1136/bmjsem-2019-000512. PMID: 31191969; PMCID: PMC6539142.
16. Brug J, Chinapaw M. Determinants of engaging in sedentary behavior across the lifespan; lessons learned from two systematic reviews conducted within DEDIPAC. Int J Behav Nutr Phys Act. 2015 Oct 9;12:134. doi: 10.1186/s12966-015-0293-2. PMID: 26453317; PMCID: PMC4600212.
17. Marconcin P, Júdice PB, Ferrari G, Werneck A, Marques A, Marconcin P, et al. Methods of Assessing Sedentary Behaviour. In: Sedentary Behaviour - A Contemporary View [Internet]. IntechOpen; 2021 [cited 2024 Jun 18]. Available from: https://www.intechopen.com/chapters/78239
18. Uddin R, Burton NW, Khan A. Factors associated with changes in physical activity and sedentary behaviour during one year among university-based young adults. Sports Med Health Sci. 2021 Oct 1;3(4):236-242. doi: 10.1016/j.smhs.2021.09.002. PMID: 35783374; PMCID: PMC9219348.
19. Ahumada Tello J, Toffoletto MC. Factores asociados al sedentarismo e inactividad física en Chile: una revisión sistemática cualitativa [Factors associated with sedentary lifestyle and physical inactivity in Chile: a qualitative systematic review]. Rev Med Chil. 2020 Feb;148(2):233-241. Spanish. doi: 10.4067/s0034-98872020000200233. PMID: 32730501.
20. Alobaid AM, Syed W, Al-Rawi MBA. Factors Associated with Sedentary Behavior and Physical Activity Among People Living in Saudi Arabia - A Cross-Sectional Study. Risk Manag Healthc Policy. 2023 Sep 27;16:1985-1997. doi: 10.2147/RMHP.S427792. PMID: 37790982; PMCID: PMC10544160.
21. Biddle SJH, Brehm W, Verheijden M, Hopman-Rock M. Population physical activity behaviour change: A review for the European College of Sport Science. European Journal of Sport Science. 2012 Jul;12(4):367–83.
22. Moreno-Llamas A, García-Mayor J, De la Cruz-Sánchez E. The impact of digital technology development on sitting time across Europe. Technology in Society. 2020 Nov 1;63:101406.
23. Woessner MN, Tacey A, Levinger-Limor A, Parker AG, Levinger P, Levinger I. The Evolution of Technology and Physical Inactivity: The Good, the Bad, and the Way Forward. Front Public Health. 2021 May 28;9:655491. doi: 10.3389/fpubh.2021.655491. PMID: 34123989; PMCID: PMC8193221.
24. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. Appl Physiol Nutr Metab. 2010 Dec;35(6):725-40. doi: 10.1139/H10-079. PMID: 21164543.

***Corresponding author**: Qamil Dika, MD, PhD. Department of Public Health, University of Medicine, Tirana, Albania. E-mail: qamildika@outlook.com*