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Review of Article: Kulinski, J.P., Sanghavi, M., Ayers, C.R., Das, S.R., Banerjee, S., Berry, J.D., Addo, T., De Lemos, J.A. & Kumbhani, D.J. Association between low ankle brachial index and accelerometer-derived sedentary time in the asymptomatic general population. *Vascular Medicine* 2015;20(4):332–338

Mary O. Whipple, BA, BSN, RN., PHN, CCRP

PhD Candidate, School of Nursing, University of Minnesota, Minneapolis, Minnesota, USA

Recently, examination of the role of sedentary time in the development and consequences of cardiovascular disease has gained popularity (1), yet there remain significant gaps in our understanding of its unique contributions, independent of exercise and physical activity. Sedentary behavior, frequently assessed through self-report measures of screen time or objectively measured through the use of activity monitors, is defined as any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents (METs) that is done while in a sitting, reclining, or lying position (2). Research has demonstrated consistent associations between cardiovascular disease morbidity and mortality that are independent of regular exercise (3) and physical activity (4), leading researchers to conclude that sedentary behavior exerts a unique influence on human health, particularly in the case of cardiovascular disease, however less is known about the unique effects of sedentary behavior in the setting of peripheral artery disease.

Lower extremity peripheral artery disease (PAD) is an increasingly prevalent and disabling atherosclerotic condition affecting an estimated 10–15% of Americans over age 65 (5). Several recent studies have examined potential associations between both self-report and objectively-measured sedentary behavior and PAD. McDermott and colleagues have demonstrated a relationship between greater self-reported sedentary time and faster decline in physical function in individuals with PAD (6), however, in a separate study, the authors did not find an independent relationship between sedentary time and all-cause or cardiovascular disease mortality (7). While higher levels of physical activity and exercise have been linked to a lower risk of development of PAD (8), studies examining the unique role of sedentary time in the development and progression of PAD are needed.

Correspondence: Mary O. Whipple, BA, BSN, RN, PHN, CCRP, University of Minnesota School of Nursing, 5-140 Weaver-Densford Hall, 308 Harvard St. SE, Minneapolis, MN 55455, P: 612-626-9620, whipp042@umn.edu.

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SUMMARY

Kulinski et al. (9) report the results of a study in which they retrospectively examined associations between objectively-measured physical activity and sedentary behavior and ankle-brachial index asymptomatic adults using population data from the National Health and Nutrition Examination Survey. The National Health and Nutrition Examination Survey (NHANES) is an ongoing sequence of surveys initiated in the 1960s designed to assess the health and nutrition of the US population. Each year, 15 locations are selected and sampled to represent the general population and participants are asked to complete an interview at their home, medical exam, and a set of medical and laboratory tests. Both objective measurement of physical activity and sedentary behavior and assessment of ankle brachial index (ABI) were added to NHANES 2003–2004.

Physical activity and sedentary behavior were measured using a single axis Actigraph accelerometer worn on the right hip during waking hours for 7 consecutive days. Physical activity intensity (moderate, vigorous) and sedentary time were defined according to previously established benchmarks for adults. Participants were divided into tertiles for trend analysis based on their average minutes of sedentary time per day. In addition to classification of activity, the authors also used mean count intensity (raw counts of the accelerometer divided by the minutes worn in a given day, then averaged across all days in which the accelerometer was worn) to capture overall activity levels.

ABI was measured via a standard protocol in participants age 40 and older. Systolic pressure was measured at the posterior tibial artery in each ankle and brachial artery in one arm. The ABI for each leg was defined as the ratio between the pressure in each leg divided by that in the arm. An ABI ≥ 0.9 is considered diagnostic for PAD, while an ABI between 0.91 and 0.99 is considered borderline. In order to increase sensitivity, the authors considered an ABI of <1.0 in either leg abnormal in their primary analysis.

In addition to physical activity and ABI, information on age, sex, race, height, weight, tobacco use, and history of atherosclerotic cardiovascular disease, hypertension, hyperlipidemia, and diabetes were collected. In order to limit analyses to asymptomatic individuals, participants who indicated that they had any limitations in the type or amount of work they could do due to physical, mental, or emotional problems, or who reported any difficulty walking without special equipment were excluded from analysis. Logistic regression models were used to examine the impact of various exposures (sedentary time and moderate/vigorous physical activity [MVPA] time) on the outcome of abnormal ABI, after adjusting for important covariates.

Of the 2238 participants who completed ABI testing, 279 were excluded due not having a least 1 day (consisting of at least 10 hours of wear) of physical activity monitoring, 332 had missing data, 5 were excluded due to ABI > 1.4 , and 179 were excluded due to reported functional impairment, leaving 1443 participants for analysis. The mean age of participants was 61 years (SD 13), mean daily sedentary time was 454 (SD 144) minutes, and mean daily time in moderate/vigorous physical activity was 18 (20 SD) minutes. Individuals in the highest tertile of sedentary time were more likely to be male, older, and have a greater

number of comorbidities including diabetes, hypertension, and known cardiovascular disease. The authors found that on average, ABI significantly decreased across sedentary time tertiles, with a mean ABI of 1.08 ($\pm$ 0.13) in the least sedentary group, 1.07 ($\pm$ 0.13) in the middle tertile, and 1.05 ($\pm$ 0.15) in the most sedentary group. The proportion of individuals with an ABI <1.00 also increased significantly across tertiles (19.6%, 21.6%, and 27.9%, respectively). In multivariable logistic regression models higher sedentary time was independently associated with greater odds of having a low ABI (odds ratio [OR] 1.22 per 1 standard deviation [SD] increase, 95% confidence interval [CI] 1.03, 1.43). Higher MVPA time was independently associated with lower odds of a low ABI (OR 0.71 per 1 SD increase in MVPA time, CI 0.57, 0.89). In sensitivity analyses, the authors found that the relationships between sedentary time, MVPA, and ABI were not significantly affected by modeling ABI as a continuous variable, modifying the definition of low ABI to $\leq$ 0.95, or excluding participants with known cardiovascular disease. The relationship between sedentary time and ABI was, however, attenuated when low ABI was defined as $\leq$ 0.90 (OR 1.26, $p=0.06$) and the relationship between MVPA and ABI was no longer significant (OR 0.81, $p=0.23$). Mean count intensity was also significantly associated with low ABI (OR 0.70, CI 0.58–0.84).

Based on their analyses, the authors conclude that among asymptomatic adults in the US general population, higher objectively-measured sedentary time is associated with low ABI, independent of MVPA and common PAD risk factors include smoking status, diabetes, age, and known cardiovascular disease. Additionally, the relationship between mean count intensity (a composite variable that aggregates all activity and sedentary time) and ABI suggests that as mean count intensity increases (i.e., any type of activity increases), the risk of low ABI decreases, highlighting the potential value of routine, non-exercise activities in preventing the consequences of cardiovascular disease. Limitations to this study include the inability to examine the direction of the relationship between ABI and sedentary behavior. Additionally, due to the small number of individuals with an ABI $\leq$ 0.90 ($n=125/1443$), the authors propose that the study may have been underpowered to detect a relationship between ABI and exercise and sedentary behavior among these individuals.

REVIEWER COMMENTS

This study provides population-level evidence of the relationships between sedentary behavior and low ABI, independent of MVPA. While there have yet to be studies examining the directionality of relationships between sedentary behavior and PAD (or low ABI), the results of the study by Kulinski et al. (9) and other work to date suggest that sedentary behavior could be an important and unique behavior target for individuals with PAD. Given that pain and needing to stop to rest are often cited as barriers to physical activity among individuals with claudication, reduction of sedentary behaviors, including increasing the number of breaks in sedentary behavior by standing or engaging in light physical activities, could be an approachable target for individuals with significant symptoms and/or those who are particularly concerned or fearful of beginning an exercise program.

Despite the rapidly expanding body of literature, there is much to be done in understanding the implications of sedentary behavior in vascular disease, including the directionality of

these relationships. It is unknown if increased sedentary behavior promotes the development of lower extremity vasculopathy (as proposed by Padilla and Fadel (10)), or if, as PAD develops, individuals may unknowingly increase their sedentary behavior to compensate for leg symptoms caused by PAD. Therefore, work examining such longitudinal associations and sedentary behavior patterns, as well as studies examining the feasibility and efficacy of sedentary behavior reduction or light activity-promotion focused interventions (or components of interventions) in improving physical function and preventing decline among individuals with PAD are needed to more fully understand the unique implications of sedentary behavior in this population.

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References

1. Ford ES, Caspersen CJ. Sedentary behaviour and cardiovascular disease: A review of prospective studies. *Int J Epidemiol*. 2012; 41(5):1338–53. [PubMed: 22634869]
2. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-cheung AE, et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act International Journal of Behavioral Nutrition and Physical Activity*. 2017; 14(75)
3. Stamatakis E, Hamer M, Dunstan DW. Screen-based entertainment time, all-cause mortality, and cardiovascular events: population-based study with ongoing mortality and hospital events follow-up. *J Am Coll Cardiol*. 2011; 57(3):292–9. [PubMed: 21232666]
4. Patel AV, Bernstein L, Deka A, et al. Leisure time spent sitting in relation to total mortality in a prospective cohort of US adults. *Am J Epidemiol*. 2010; 172(4):419–29. [PubMed: 20650954]
5. Criqui MH, Aboyans V. Epidemiology of peripheral artery disease. *Circ Res*. 2015; 116(9):1509–26. [PubMed: 25908725]
6. McDermott MM, Liu K, Ferrucci L, et al. Greater sedentary hours and slower walking speed outside the home predict faster declines in functioning and adverse calf muscle changes in peripheral arterial disease. *J Am Coll Cardiol*. 2011; 57(23):2356–64. [PubMed: 21636037]
7. McDermott MM, Guralnik JM, Ferrucci L, Tian L, Kibbe MR, Green D, et al. Community walking speed, sedentary or lying down time, and mortality in peripheral artery disease. *Vasc Med*. 2016
8. Delaney JAC, Jensky NE, Criqui MH, Whitt-glover MC, Lima JAC, Allison MA. The association between physical activity and both incident coronary artery calcification and ankle brachial index progression: The Multi-Ethnic Study of Atherosclerosis. *Atherosclerosis*. 2013; 230(2):278–83. [PubMed: 24075757]
9. Kulinski JP, Sanghavi M, Ayers CR, et al. Association between low ankle-brachial index and accelerometer-derived sedentary and exercise time in the asymptomatic general population. *Vasc Med*. 2015; 20(4):332–8. [PubMed: 25883159]
10. Padilla J, Fadel PJ. Prolonged sitting leg vasculopathy: contributing factors and clinical implications. *Am J Physiol - Hear Circ Physiol*. 2017; 313:H722–8.