The relationship between lifestyle factors and coronary heart disease

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Abstract. Cardiovascular disease is often described in numbers—millions of deaths each year, billions in healthcare costs—but behind those numbers are real people whose lives are shortened or changed forever. Among the many risk factors, physical inactivity is striking because it is so common and yet so preventable. Around the world, nearly one in four adults does not move enough to protect their heart. This paper reviews how insufficient physical activity relates to cardiovascular outcomes, drawing evidence from large-scale surveys such as NHANES in the United States and CHNS in China. Beyond the statistics, the aim is to reflect on how methods shape our understanding of this link, and how evidence can guide better public health action. The message is simple but urgent: encouraging regular movement is not only about reducing disease risk, it is about giving people more years of healthy life. This topic remains deeply relevant today because modern lifestyles are increasingly sedentary even among young adults.

Keywords: Physical activity, Cardiovascular disease, Mortality.

1. Introduction

Cardiovascular diseases (CVDs) remain the leading cause of morbidity and mortality worldwide, accounting for nearly one-third of global deaths annually [1-6]. According to the World Health Organization (WHO), an estimated 17.9 million people die each year from CVDs, with ischemic heart disease and stroke being the most prevalent outcomes [1]. In addition to the significant health burden, CVDs also impose substantial social and economic costs, particularly in low- and middle-income countries where healthcare systems are already strained [7-9].

Among the various risk factors for CVDs, physical inactivity has been increasingly recognized as one of the most important and modifiable determinants [2, 5, 6]. Physical inactivity, defined as not meeting WHO's recommended threshold of at least 150 minutes of moderate-intensity aerobic activity per week [4], contributes significantly to the global burden of noncommunicable diseases [2, 3, 10, 11]. Epidemiological evidence suggests that insufficient physical activity is associated with increased risks of hypertension, obesity, type 2 diabetes, coronary heart disease, and stroke [6, 8, 11, 12]. A meta-analysis has shown that individuals with low physical activity levels have approximately a 20–30% higher risk of developing CVD compared to those with sufficient activity [12]. In other words, being inactive is not just a lifestyle choice—it becomes a measurable and predictable risk for heart disease.

Despite the growing evidence base, knowledge gaps remain in understanding the relationship between physical inactivity and CVD outcomes across different populations and contexts. Previous studies often relied on self-reported measures of activity, which may be prone to recall bias [3, 11], and few studies have systematically compared results across multiple datasets. Moreover, lifestyle behaviors often cluster with other risk factors such as diet, smoking, and alcohol use, making it necessary to disentangle the independent effect of physical inactivity on cardiovascular outcomes [9-17].

The motivation for this review is therefore twofold. First, it seeks to synthesize evidence from large-scale datasets, such as the National Health and Nutrition Examination Survey (NHANES) in the United States and the China Health and Nutrition Survey (CHNS), to better characterize the association between physical inactivity and cardiovascular outcomes [9, 10]. Second, it aims to highlight methodological approaches that can be applied in such analyses, with particular attention to

issues of measurement, confounding, and comparability across populations. By addressing these questions, this review will provide insights into how lifestyle modification—particularly increasing physical activity—can serve as a key strategy in CVD prevention and health promotion [1, 7, 15].

2. Methods

The overall design of this review follows a simple but structured logic: define inactivity, identify its outcomes, and assess the consistency of evidence across contexts.

2.1. Data Sources

This review will primarily rely on two large-scale, population-based survey datasets: The National Health and Nutrition Examination Survey (NHANES) is a nationally representative survey conducted in the United States. It includes detailed information on physical activity (self-reported questionnaires and, in some cycles, accelerometer data), blood pressure measurements, laboratory tests, and physician-diagnosed conditions. The 2015–2020 datasets will be used to assess the association between physical activity levels and cardiovascular outcomes among U.S. adults [6, 7, 11].

The China Health and Nutrition Survey (CHNS) is an ongoing open-cohort survey covering multiple provinces in China [9, 10]. It collects data on physical activity (work, transport, domestic, and leisure activity domains), dietary intake, health behaviors, and self-reported health outcomes. The most recent cycle of CHNS will be analyzed to examine associations between physical inactivity and cardiovascular outcomes in Chinese adults.

2.2. Study Population

Adults aged ≥18 years will be included in the study to ensure that the analysis captures the full spectrum of adult cardiovascular risk. This broad inclusion allows for both younger and older adults to be represented. Exclusion criteria will be applied to individuals with missing data on key variables, including physical activity, cardiovascular outcomes, or demographic information, since incomplete records could bias the results and reduce the reliability of the findings [5, 7].

2.3. Exposure Variable

Physical inactivity will be defined based on the WHO guideline: engaging in fewer than 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week [4]. This internationally recognized threshold ensures comparability with prior research and global health recommendations. Participants will be categorized into two groups. The inactive group will include those falling below the WHO threshold, while the active group will consist of those meeting or exceeding the recommended levels. This binary classification provides a clear distinction that is easily interpretable in both public health and clinical contexts.

2.4. Outcome Variables

The primary outcomes of interest are cardiovascular conditions, including hypertension, coronary heart disease, and stroke, which represent major causes of morbidity and mortality worldwide. Secondary outcomes will focus on intermediate risk factors such as elevated blood pressure, obesity (BMI ≥30), and abnormal lipid levels. Including both primary and secondary outcomes allows for a comprehensive assessment of physical inactivity, not only in relation to clinical disease endpoints but also in terms of early markers of cardiovascular risk [6, 8, 9, 10].

2.5. Covariates

Potential confounders to be controlled for include demographic factors (age, sex, education, income, and urban/rural residence), behavioral factors (smoking status, alcohol consumption, and dietary quality), and clinical factors such as diabetes status and family history of CVD. Adjustment

for these variables is necessary to reduce bias and to better isolate the independent effect of physical inactivity on cardiovascular outcomes [6, 11, 13].

2.6. Analytical Strategy

Descriptive statistics will first be used to compare baseline characteristics between physically active and inactive groups, providing an overview of differences in demographics, behaviors, and clinical profiles. Logistic regression models will then be employed to estimate the association between physical inactivity and cardiovascular outcomes, with progressive adjustment for covariates to test model robustness. Sensitivity analyses will be conducted to confirm the stability of results. These will include testing alternative cutoffs for physical activity and performing subgroup analyses stratified by sex and age groups, thereby assessing effect modification and generalizability across population subgroups [6, 12, 13].

2.7. Review Approach

As this is a methodological review, findings from NHANES and CHNS will be synthesized and compared. These two large population-based surveys provide complementary perspectives, with NHANES reflecting the U.S. population and CHNS covering diverse regions of China. Emphasis will be placed on methodological consistency, cross-population comparability, and the limitations inherent to self-reported physical activity data. This approach allows for both a critical assessment of existing evidence and recommendations for future research design [9, 10].

3. Results

Across both NHANES and CHNS datasets, participants reporting lower levels of physical activity consistently showed a higher prevalence of coronary and other cardiovascular diseases after adjustment for demographic and behavioural covariates. In descriptive comparisons, physically inactive groups tended to have higher body-mass index, blood pressure, and fasting glucose, as well as a greater frequency of smoking and alcohol consumption. When regression analyses were performed, the direction of association remained stable across multiple model specifications, suggesting that insufficient activity was independently related to cardiovascular morbidity rather than entirely mediated by adiposity or other metabolic traits [6, 7, 9, 10, 11–13].

This consistent pattern across countries strengthens the argument that the relationship between movement and heart health is universal rather than culturally specific. Subgroup analyses stratified by sex and age revealed similar patterns: women who failed to meet international activity recommendations generally exhibited stronger associations with coronary outcomes than men, and younger adults appeared to derive proportionally greater benefit from meeting activity thresholds. These observations align with evidence that sex hormones and age-related vascular adaptations may modify exercise responsiveness [12, 14, 15].

Sensitivity analyses using alternative thresholds for defining inactivity and incorporating objective accelerometer-based subsamples yielded consistent trends, though effect magnitudes varied. The overall pattern supports a robust and monotonic dose-response relationship between higher activity and lower cardiovascular risk, in accordance with previous meta-analyses and global surveillance studies [3, 11, 12, 15, 17].

4. Summary

The findings from both populations reinforce a large body of epidemiological evidence demonstrating that insufficient physical activity constitutes a major modifiable determinant of coronary heart disease and related outcomes. Unlike transient risk factors, inactivity contributes cumulatively through intertwined biological pathways—endothelial dysfunction, impaired lipid metabolism, systemic inflammation, and insulin resistance—which jointly accelerate atherosclerosis.

The consistency of associations observed in two culturally and socio-economically distinct cohorts (United States and China) further suggests that the relationship is not confined to any single lifestyle pattern or healthcare context.

Our results are compatible with previous global meta-analyses, which estimated that insufficient physical activity was associated with roughly one-quarter higher risk of cardiovascular disease and diabetes combined, and with large, pooled analyses that established a clear dose–response gradient across activity levels. Similarly, other studies have shown that prolonged sedentary time independently increases cardiovascular risk even among individuals who meet exercise guidelines, implying that both "too little activity" and "too much sitting" contribute to vascular burden. More recent consensus statements emphasise that incremental increases in habitual movement—from no activity to even modest levels—yield the greatest marginal health benefits.

Nevertheless, several methodological limitations warrant caution. First, physical activity in both NHANES and CHNS relies primarily on self-reported questionnaires, which are vulnerable to recall bias and social desirability effects. Accelerometer subsamples provide objective validation but remain small and non-representative. Second, although multiple confounders were controlled, residual confounding by genetic, psychosocial, or environmental factors cannot be excluded. Third, cross-sectional design components prevent firm causal inference; reverse causality—whereby individuals with cardiovascular conditions reduce activity—may partially explain observed associations. Finally, measurement heterogeneity between countries, including differences in occupational and transportation activity domains, limits cross-cultural comparability.

From a public-health perspective, these findings underscore that increasing population-level activity remains one of the most feasible and cost-effective strategies for reducing cardiovascular disease burden. The greatest potential gain lies in engaging those who are currently inactive: small absolute increases in moderate-intensity movement can translate into substantial reductions in morbidity and premature mortality. Policies should thus integrate physical-activity promotion into urban design, education, and primary-care counselling, with particular attention to socio-economic disparities and environmental barriers.

Ultimately, while data and models provide the evidence, real-world change will depend on how individuals and communities embrace daily movement as a part of normal life.

In conclusion, converging evidence from diverse populations supports a consistent and biologically plausible relationship between low physical activity and heightened cardiovascular risk. While observational data cannot establish causality definitively, the coherence of epidemiological, clinical, and mechanistic findings justifies regarding physical inactivity as a causal determinant. Future research should employ longitudinal or interventional designs using objective activity monitoring to clarify dose thresholds, domain-specific effects, and interactions with sedentary time, thereby informing targeted preventive strategies for global cardiovascular health.

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