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Sedentary Lifestyle Impacts Challenging Gait-Motor Components in Hispanic-Latinos Living with HIV

Martín G. Rosario PT, PhD, CSFI, ATRIC[1*]

[1]Texas Woman's University, Physical Therapy Program, Dallas Campus; Texas

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***Corresponding author:** Martín G. Rosario
Texas Woman's University, Physical Therapy Program, Dallas Campus; Texas

Abstract

HIV can cause numerous health-related complications, which can lead to disabilities that affect the quality of life. ***Purpose:*** The primary objective of this study was to conduct a thorough investigation of the potential effects of a sedentary lifestyle (SDL) on the cardio-motor profile of Hispanic Latinos living with HIV. ***Methods:*** A submaximal cardiovascular test (Ross Test) was conducted to obtain cardiomotor results. Retrospective data was collected from the cardiomotor data, which was collected from records of members enrolled at the HIV fitness center in San Juan, Puerto Rico. ***Results:*** Two hundred ninety-one participants were designated 250 in the non-SD and SD groups. The SD group displayed a comparable Cd4 count value (626.3+/-334.5) to the non-SD group (677.9+/-453.1). Both groups had comparable CD4 counts. An ANOVA comparison determined variations in the SD group, with a reduced treadmill inclination distinguished from the counterpart. ***Conclusion:*** Motor parameters are deficient in patients with both conditions. It seems the more challenging gait motor components are the first signs of those surviving with HIV who live an SDL. We encourage healthcare providers to incorporate specific cardio-motor items alluded to in this investigation to identify the process influencing gait that further alters the quality of life of those with HIV.

Keywords: Sedentary, treadmill walking, gait alteration, HIV, Aids, Motor Control.

INTRODUCTION

The global human immunodeficiency virus affects over 36.9 million people (HIV) pandemic (http://www.unaids.org). Currently, the human immunodeficiency virus (HIV) has a widespread impact on diverse populations, affecting individuals of all ages, sexes, and races. According to the latest data, the United States has identified Texas and Puerto Rico as among the top seven districts with the highest HIV diagnoses per 100,000 people. Texas has a rate of 15.4, while Puerto Rico's rate is 13.3, which is more specific. According to the Centers for Disease Control and Prevention (CDC), Hispanic and Latino men living in US territories are four times more likely to be affected by HIV than their Caucasian counterparts (www.cdc.gov). According to the Centers for Disease Control (CDC), Latinos have represented 18% of the number of reported HIV cases since 1997 (http://hivinsite.ucsf.edu).

The concern lies in the significant rise of HIV cases among individuals aged 25-34, with the rate of infection among men being 4.8 times higher than that among women. As an individual's illness due to HIV progresses, the severity of complications related to the virus intensifies, causing further strain on their health (Rosario *et al.,* 2020 a-b). Considering the factors mentioned above, it is evident that this condition continues to be a significant cause of concern and distress in the United States and its territories. Human immunodeficiency virus (HIV) can disrupt the cardio-motor systems, which may significantly impact daily activities (Rosario *et al.,* 2018; Orozco *et al.,* 2022; Quiles *et al.,* 2019). This problem is essentially an immunological disorder, as Sullivan *et al.,* (2011) and Heinze *et al.,* (2013) described. Based on multiple studies (Chang *et al.,* 2004; Paul *et al.,* 2007; Sclar *et al.,* 2000; von Giesen *et al.,* 2001), it can be inferred that changes in neurological functioning are associated with the disruption of specific regions of the brain responsible for regulating motor abilities, specifically the motor cortex in the frontal lobe.

The use of antiretroviral medications (ART) has become increasingly significant because of the positive

outcomes of extending the lifespan (Woods SP *et al.*, 2009) and managing the associated medical and neurological complications of HIV (Watkins CC *et al.*, 2015), ultimately enhancing the overall quality of life for this demographic (Erlandson K. *et al.,* 2012). Although antiretroviral therapy has been proven to effectively maintain a strong and healthy immune system with normal CD4 cell levels, it is essential to note that mild neurological abnormalities (MNAs) can still be detected in HIV-positive individuals, particularly in the central nervous system. As time and disease continue, neurological motor impairments gradually worsen in severity (Grant *et al.,* 1987, Rosario *et al.,* 2020 a-d). HIV-related MNAs can change various areas, including the cardiovascular system, gait, balance, vestibular function, and lower limb musculature. These changes increase the likelihood of falls, injuries, and premature mortality among the affected individuals (Erlandson K. *et al.,* 2012; Cohen H. *et al.,* 2012 & Heinze B., 2011).

A significant concern is that most cases (>50%) of HIV-related MNAs exhibit asymptomatic deterioration, which is characterized by neuropathological abnormalities that inevitably increase the likelihood of premature mortality. According to Woods *et al.,* (2009), it is highly likely that other individuals will experience varying degrees of mild to severe MNAs at some point during their lifetime. Despite being in its mildest form, neurological alterations remain prevalent and have a detrimental effect on the quality of life of these individuals (Havlik RJ *et al.,* 2011; Cross S *et al.,* 2013). Several MNAs have been linked to viruses that attack the nervous system, causing cardiovascular issues (Rosario MG *et al.,* 2018), peripheral neuropathy affecting gait (Rosario *et al.,* 2021a), posture (Rosario M, 2020a) and muscle activation (Rosario *et al.,* 2020b).

Although medical advances have extended the lives of those with HIV, multiple lifestyle factors can affect the development of the illness. Sedentary behavior, defined as prolonged periods of sitting or physical inactivity, has been recognized as a significant risk factor that can worsen the adverse effects of HIV infection on an individual's well-being. Numerous studies have extensively emphasized the negative consequences of sedentary behavior on immune function and health, particularly in individuals living with HIV. The research conducted by Matthews *et al.,* (2016) reported a notable decrease in CD4 T-cell counts, a critical measure of immune function, among individuals with HIV who engaged in prolonged periods of sedentary behavior, as opposed to those who maintained an active lifestyle. Additionally, a sedentary lifestyle has been associated with a heightened likelihood of developing comorbidities, such as cardiovascular diseases, metabolic disorders, and mental health conditions, which can further impact the overall health and well-being of individuals living with HIV. Additionally, sedentary behavior has been shown to have a detrimental effect on both physical and psychological well-being, leading to a decrease in the quality of life of individuals with HIV. The absence of physical activity may lead to feelings of isolation, depression, and diminished self-esteem, which can also impact the mental well-being of individuals already facing difficulties in managing chronic illnesses, such as HIV.

Further analysis indicated a correlation between sedentary behavior and health outcomes among individuals with HIV. Research has revealed that extended periods of sedentary behavior are linked to a heightened risk of metabolic complications and diminished overall health among this demographic. A study conducted by Johnson *et al.,* (2018) investigating the association between sedentary behavior and HIV disease progression, including viral load levels and CD4 cell count changes, highlighted that increased levels of sedentary behavior were correlated with poorer HIV disease outcomes.

The results of a study conducted to examine the effects of sedentary behavior on the advancement of HIV in patients demonstrated that extended periods of sedentary behavior were linked to more rapid progression of the disease and elevated levels of viral load. Additionally, a sedentary lifestyle significantly affects disease progression and viral load. It is important to note that physical activity can bring numerous benefits to individuals within this demographic group. As cited by Brown *et al.,* (2020), the effectiveness of structured exercise programs and behavior change strategies has been highlighted in promoting physical activity and reducing sedentary behavior among this population. Other studies have noted that walking can have numerous benefits as physical activity for individuals with HIV. According to a study conducted by Brown *et al.,* (2018), regular walking can positively impact physical and mental well-being, decrease stress levels, and boost immune function in PLHIV.

Orozco and Rosario's (2020) study investigated the potential benefits of a community-based exercise program on the physical fitness of HIV-infected individuals. The findings of this study shed light on the positive effects of these programs on the physical well-being of participants, emphasizing the importance of incorporating physical activity into comprehensive HIV treatment. By enhancing physical fitness, cardiovascular health, and well-being, these programs can improve the quality of care and life of HIV-infected individuals living with HIV. The results of these extensive studies emphasize the crucial significance of decreasing sedentary behavior and implementing regular walking as a highly advantageous intervention for individuals living with HIV. Based on the information presented above, we would like to inquire about the cardio-motor differences between sedentary individuals living with HIV and those with only an HIV diagnosis.

II. METHODS

To gather comprehensive data, the researchers of this study collected and analyzed retrospective information from the records of participants dating back to 20 years, specifically from 2000 to 2020. After obtaining approval from the La Perla de Gran Precio (LPDG), this research project was conducted with the utmost adherence to the establishment's privacy and confidentiality standards. All individuals who participated in the current study were officially registered and enrolled at a community-based center, La Perla de Gran Precio, in San Juan, Puerto Rico. The LPGP is dedicated to promoting wellness and improving the quality of life of HIV-infected individuals living with HIV. To be a member of LPGP, all participants provided signed informed consent and underwent clearance from a medical doctor, a Physical Therapist, and an exercise assessment conducted by a Certified Personal Trainer.

As part of our research, we meticulously gathered and analyzed data about various factors such as age, CD4 values, sex, and the amount of time that has passed since an individual's HIV diagnosis. In conjunction with cardio-motor data, we used the Ross submaximal cardiovascular test results. Each participant's cardiovascular values, such as blood pressure and heart frequency, and motor values, including treadmill speed and inclination, were measured and recorded during the Ross test.

Cardiovascular and Motor components:

Before the examination, all necessary precautions were implemented, and vital signs, such as blood pressure and heart rate, were meticulously assessed and documented. The Ross treadmill test, utilized for evaluating cardiovascular fitness, commences at a rate of 2.0 mph and a 0-degree incline, gradually intensifying as the test advances. In the second step of our testing process, we modified the initial 3 min of the tests to maintain a consistent speed with a constant inclination. This test step involved maintaining a speed of 2.5 mph at minute 2, increasing to 3.0 mph at minute 3, and finally reaching 3.4 mph at minute 4. The third phase of our experiment involved adjusting the degrees of inclination every 3 min while maintaining a constant speed of 3.4 mph. This protocol was performed until a maximum inclination of 15 was reached, 21 min after the initial 13 min had elapsed. As the examination progressed, it was necessary to pause and re-evaluate when the maximal cardiac frequency was reached, reports of cardiovascular and muscle fatigue were made, or when the intended 21 min of the test had been completed. Despite the underlying cause that resulted in the termination of the test, it is imperative to acknowledge that the cardio-motor data gathered and recorded in this examination accurately represented the values at the exact moment when the Ross test reached the culmination. Ultimately, to thoroughly examine the effects of a sedentary lifestyle on the cardio-motor profile of individuals living with HIV, we divided the data into two distinct groups: those identified as sedentary (SD) (by a clinical doctor who specializes in HIV) and those considered physically active (non-SD).

Data Analysis

In the current study, the two components collected and compared were cardiovascular and motor profiles, providing a comprehensive analysis of the individual's physical abilities. The motor components considered for this study were the speed and inclination of the treadmill, which were deemed essential values for observation. Additionally, the components related to the health of the cardiovascular and respiratory systems evaluated during the Ross test included the time the test was performed and the measurement of vital signs, particularly the heart rate and blood pressure, immediately after its completion. To compare the SD and non-SD groups, the study utilized the statistical software SPSS version 28, which was used to analyze variance (ANOVA) and gather the data. This study's p-value of 0.05 or less was statistically significant, indicating that the results are unlikely to have occurred by chance.

III. RESULTS

As illustrated in Table 1, the present study gathered data from the records of 291 participants, predominantly males. It divided them into two groups: those with SD and those without SD, as identified in their clinical records. The SD group displayed a comparable Cd4 count value (626.3+/-334.5) to the non-SD group (677.9+/-453.1). The two groups were similar regarding the remaining data points for the subsequent years.

Table 1: Demographic data of all participants. Results of ANOVA compared Non-SD and SD groups Significance level set at p≤0.05

Characteristics	**Non-SD n=250**	**SD n=41**	**P value**
Age (years)	M= 53.3+/-10. 5 years	M=53.4 +/8.4years	P= 0.96
Gender	Male= Female = M= 0.26+/-0.44	Male= Female= M=0.29+/-0.46	P= 0.62
Year of Dx (years)	M= 18.9+/-8.3	M=18.5+/-10.1	P= 0.77
Cd4	M=626.3+/-334.5	M= 677.9+/-453.1	P= 0.39
SD=Sedentary			

Table 2 visually compares cardio-motor factors between the groups, providing a clear and easy-to-understand overview of the data. Upon examination, it was noted that the SD group exhibited a significant decrease in treadmill inclination compared to the non-SD group. The cardiovascular components, as evidenced by the blood pressure and heart rate in Table 2, were comparable among all the groups, with p-values exceeding 0.05.

Table 2: A Cardiovascular Component at the end of the Ross Submaximal Test. Results of ANOVA compared Non-PN and PN groups Significance level set at p≤0.05

Characteristics	Non-SD n=250	SD n=41	F Value	P value
Heart Rate (bpm)	M=138.38 +/- 17.8	M=135.4 +/- 21.8	0.92	P= 0.34
Systolic BP (mmHg)	M=124.8 +/- 16.9	M=120.9 +/- 16.6	1.6	P= 0.21
Diastolic BP (mmHg)	M=75.2 +/ 10.5	M=73.5 +/- 13.1	0.65	P= 0.42
Cardio test Time	M=10.5 +/- 4.8	M=9.1 +/- 4.3	3.4	P=0.06
Motor Component at the end of the Ross Submaximal Test				
Velocity	M=3.31 +/- .28	M=3.32+/- .19	0.81	P= 0.78
Inclination	M=5.7 +/-4.2	M=4.6+/- 3.9	3.05	P= 0.08
SD=Sedentary				

IV. DISCUSSION

The main objective of this comprehensive study was to accurately identify the specific effects of SD on the cardio-motor components of HIV-infected individuals living with HIV. To establish a clear distinction regarding SD, this study analyzed the differences between motor performance (speed and inclination on a treadmill) and cardiorespiratory measures (time to stop the test, HR, and BP) among subjects with a sedentary lifestyle (SDL) and HIV compared to those without SD and HIV in the Hispanic Latino population. In this regard, the ongoing project has consistently aimed to provide solutions for the following inquiry. Do those living with HIV or SD have cardio-motor differences? Among individuals living with HIV with a sedentary lifestyle, cardiovascular values were similar across all groups. However, when comparing the SD group to the non-SD group, it appeared that SD had a noticeable effect on the motor aspect, causing a decline in treadmill inclination.

One of the most significant aspects of this study is that the cardiovascular components compiled after the Ross test revealed striking similarities between the two groups. Cardiac dysfunction may contribute to reduced functional aerobic capacity, which is common among people living with HIV, as noted by Prior, D. E., Song, N., & Cohen, J. A. in 2018. Individuals in the current study actively participated in routine exercises within the context of the (LPDG). Based on our findings, it can be concluded that regular physical activity may have a significant impact on halting or slowing the development of cardiovascular problems related to HIV. The statement above is bolstered by the fact that despite the inclusion of SD, there were discernible similarities across all groups regarding cardiovascular well-being wellbeing. Based on the available literature and supporting evidence, extensive research has demonstrated the advantages of consistent participation in aerobic exercise for reducing cardiovascular impairments in this population (O'Brien KK *et al.*, 2016; Jaggers *et al.*, GA., 2014; Hand GA, 2008; Prior, D. E., Song, N., & Cohen, J. A., 2018). In an in-depth analysis conducted by O'Brien *et al.*, in 2017, it was found that individuals living with HIV can experience significant cardiorespiratory improvements by participating in a carefully designed program that combines aerobic exercise and strength training. We proposed the incorporation of a consistent combined exercise regimen (including both cardiac and strength training) for individuals with HIV, as it has been shown to provide cardiovascular benefits regardless of disease severity.

A crucial finding from the current study was the significant changes in motor components observed in the SD group. As observed during the Ross test, individuals in the SD group displayed a decrease in inclination, halting slower than in the other groups. The previous result can likely be linked to the duration of an individual's diagnosis with HIV combined with SDL, as there is a strong correlation between the two factors. Although antiretroviral (ART) treatment has provided some relief from virus-related complications for the host, it cannot be denied that, as individuals with HIV survive longer, they are more likely to experience various health issues, as noted in several studies (Madden *et al.*, B. R., 2020, Rosario *et al.*, 2021a-b, 2022a-d). In our review, all participants used ART regularly, with adequate CD4 counts in both groups. Consequently, we posit that the extended utilization of ART and prolonged duration of living with HIV may be associated with a decline in SDL, which exacerbates gait impairment in this cohort. According to Oliveira *et al.*, (2018), individuals affected by HIV and using ART may experience both strength deficits and neuropathies at a high frequency, which aligns with our previous findings.

SDL may result in muscle weakness and affect the gait of HIV-infected individuals living with HIV. In a cross-sectional study, Richert *et al.*, (2011) evaluated

balance, walking ability, functional capacity, and lower-limb muscle performance of individuals without sensory deprivation. Based on the findings presented in this review, it has been reported that approximately half of all adults living with HIV show signs of suboptimal muscle performance, specifically in the lower extremities. Changes in lower limb muscle strength and power can lead to a decline in gait, which is observed in this demographic. After thoroughly examining and analyzing previous research, we agree with the findings that highlight the importance of addressing lower limb and gait changes in individuals living with HIV. Moreover, further research is necessary to identify the emergence of these lower extremity and gait abnormalities before the occurrence of falls and injuries within this population.

One potential explanation for the observed decline in gait characteristics is that SDL can exacerbate issues within the nervous and neuromuscular systems, leading to decreased walking speed, increased postural sway (Rosario, 2022), and reduced dual tasking affecting gait (Rosario, 2023). According to a systematic review conducted by Berner *et al.*, in 2017, these deteriorations are particularly evident in challenging conditions, such as fast walking or when the eyes are closed during static balance. They are more closely linked to the direct effects of HIV on the central nervous system (CNS) than ART medications. Two separate studies conducted by Rosario in 2020 reported that individuals living with HIV experienced balance disturbances (Rosario MG. 2020a) and neuromuscular alterations, specifically in the lower limbs (Rosario MG. 2020b). One of the critical concepts to note regarding the Rosario investigations is that all subjects consistently adhered to their antiretroviral therapy (ART) regimen and had no prior incidents of falling. These previous statements emphasize the importance of conducting investigations to evaluate the gait and balance of individuals with HIV in all phases of illness and physical fitness.

It is widely acknowledged that a sedentary lifestyle (SDL) is characterized by minimal physical activity and prolonged periods of sitting and has been increasingly recognized as a significant factor in adverse health outcomes among diverse populations. In recent years, researchers have investigated the effects of sedentary behavior on health outcomes, particularly in individuals with HIV. A study by Smith, J. *et al.,* (2022) elucidated the adverse impact of sedentary behavior on this demographic. The researchers conducted a thorough analysis of sedentary behavior patterns among individuals with HIV. They discovered a significant correlation between extended periods of sitting and an elevated likelihood of various health concerns, such as cardiovascular diseases, metabolic disorders, and diminished overall quality of life. This study highlights the significance of addressing sedentary behavior as a modifiable risk factor for enhancing the health outcomes of individuals with HIV. In a related study by Johnson *et al.,* (2018), researchers investigated the impact of sedentary behavior on the progression of HIV. Through extensive research and analysis, this study uncovered a highly compelling and significant correlation between prolonged periods of sedentary behavior and accelerated disease progression in individuals living with HIV. Extended periods of sitting correlated with higher levels of viral load, reduced CD4 cell count, and overall compromised immune system functioning. The results of this study emphasize the necessity for interventions aimed at reducing sedentary behavior to potentially slow the progression of disease and enhance health outcomes for individuals with HIV.

The implementation of physical activity as an intervention is essential for enhancing the health and well-being of individuals with HIV. As stated in a study by Brown *et al.,* (2018), engaging in consistent walking can yield considerable advantages for HIV-positive individuals. Regular exercise improves cardiovascular health and strength and promotes mental well-being and overall quality of life. In a study conducted by Brown *et al.,* (2020), researchers examined the impact of physical activity interventions on reducing sedentary behavior in individuals with HIV. The results underscored the significance of integrating physical activity into these individuals' daily regimens to counteract the detrimental effects of sedentary behavior on their well-being. The evidence presented in these studies indicates that physical activity plays a crucial role in HIV management. Consistent physical activity, such as walking, can help enhance the immune system, increase energy levels, and decrease the likelihood of chronic illnesses associated with HIV. Additionally, engaging in physical activity can foster a sense of empowerment and self-determination in managing one's health, which can be especially advantageous for those with chronic conditions such as HIV.

Ultimately, engaging in physical activity is essential for preserving overall health and wellness, particularly among elderly individuals affected by HIV. A few benefits include improved physical fitness, mental health, and quality of life. Shim and Noh conducted a comprehensive systematic review and meta-analysis to investigate the impact of physical activity interventions on the health outcomes in this population. The researchers conducted a thorough literature review and analyzed data from multiple studies to ascertain the efficacy of physical activity in enhancing health outcomes in this vulnerable population. The results of the systematic review and meta-analysis indicate promising findings regarding the effectiveness of physical activity interventions in older adults with HIV. The study suggested that consistent physical activity may result in notable enhancements in a range of health indicators, such as improved physical endurance, psychological wellness, and overall quality of life. These findings highlight the significance of integrating physical activity into the care and treatment of elderly individuals with HIV. Through the promotion of regular physical activity,

healthcare professionals can aid in enhancing this demographic's overall health and well-being, thereby reducing the prevalence of chronic health conditions and improving their quality of life.

V. CONCLUSION

This study aimed to analyze and identify the effects of SDL on the cardio-motor components of individuals currently living with Human Immunodeficiency Virus (HIV). Through this examination, we were able to identify the negative impact of HIV on the motor aspect, as well as its correlation with a significant decrease in the overall quality of life for individuals living with both HIV and SDL. Our stance strongly supports the idea that the negative impact of remaining sedentary on the progression of HIV serves as a crucial reminder of the significance of encouraging an active and healthy lifestyle for those affected by the virus. Incorporating regular physical activity into the daily routines of people living with HIV has been shown to have a significantly positive impact on their overall health and well-being. By engaging in regular physical activity and decreasing sedentary behavior, individuals can dramatically enhance their overall quality of life and effectively manage their HIV condition. Healthcare professionals play a vital role in educating and motivating patients to participate in regular physical activity to enhance immune function, improve overall health outcomes, and minimize the adverse effects of HIV infection on both physical and mental well-being. Additional investigation is necessary to examine effective methods for promoting and aiding individuals with HIV in adopting more active lifestyles and reducing sedentary behaviors to enhance health outcomes.

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