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Tanjeev Ahmad  
*Wright State University - Main Campus, ahmad.29@wright.edu*

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Effect of HIV prevalence and Gender on Cardiovascular Disease Deaths

Tanjeev Ahmad

Amber Todd, Office of Medical Education

Track

Scholarship in Medicine Final Report

**By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission**

**Abstract**

*Objective:* (State your objective). *Methods:* (Describe your methods). *Results:* (Provide your results).

Cardiovascular disease is a widely diagnosed condition that can have many etiologies and factors that changes its prognosis. This project was aimed at investigating two potential factors that changes its prognosis: HIV status and gender. Data on HIV status was collected from NCHHSTP AtlasPlus for all US states and territories and data on cardiovascular disease deaths and corresponding gender was collected from Interactive Atlas of Heart Disease and Stroke for all US states and territories. Using a linear regression test, a correlation was tested for between HIV status and cardiovascular disease deaths for every US state/territory followed by a test between gender and cardiovascular disease deaths for every US state/territory. The study did not yield

significant results between HIV status and cardiovascular disease deaths, a rise in .006 deaths for every case of HIV, however it did yield statistically significant data between gender and cardiovascular disease deaths, 161 fewer deaths per thousand in females versus males.

Key Words: cardiovascular disease, HIV, mortality

## Introduction/Literature Review

Cardiovascular disease has been a significant diagnosis made in the United States due to how drastically it affects the day to day life of the person diagnosed with it. It is also a diagnosis that is being made more frequently due to its association with obesity and hypertension which are concurrently on the rise. To minimize its prevalence, it is important to investigate what factors are associated with cardiovascular disease; One possible factor that can be associated with cardiovascular disease is HIV. In a study conducted on biventricular heart function on adults with Human Immunodeficiency Virus (HIV) infection, a correlation was found between echocardiograph detected ventricular wall deformation and having HIV <sup>1</sup>. Therefore, there is evidence that HIV status can possibly lead to subclinical myocardial dysfunction.

A separate study also found a positive correlation between HIV status and cardiovascular disease, in the form of ischemic electrocardiography by gender <sup>2</sup>. According to this study, women who were HIV positive were at twice the risk of having myocardial ischemia compared to men who were HIV positive. Therefore, it will be important to monitor HIV patients more carefully according to gender due to an increased risk for cardiovascular disease for women. One of the cardiovascular complications that can arise in HIV patients is a risk for atrial fibrillation which can lead to thromboembolisms and consequent brain strokes <sup>3</sup>. Therefore, HIV patients had an increased risk of ischemic stroke and systemic embolism along with major bleeding as cardiovascular complications compared to patients without HIV.

If a correlation is found between HIV and cardiovascular risk, a treatment plan needs to be devised to provide patients with a way to minimize the severity of their cardiovascular disease. One study investigated a possible treatment route by assessing the effectiveness of an 8 week aerobic exercise program on heart rate variability in people living with HIV taking anti-retroviral

therapy (ART), the researchers were unable to conclude that aerobic exercise had an effect on heart rate variability but were able to obtain data that suggested overall autonomic function improved across time with aerobic exercise <sup>4</sup>. While it has already been suggested that exercise has positive effects on mortality in obesity and hypertension prognosis, due to their exacerbation being major factors leading to cardiovascular disease, it is also a significant finding that aerobic exercise can positively impact the prognosis of cardiovascular disease in HIV patients; thereby providing emphasizing the role of aerobic exercise as a potential treatment route for patients with cardiovascular disease and HIV. Another study investigated an alternative treatment plan by studying immature platelet function (IPF) of HIV patients who were on ART. According to a previous research study done, IPF was increased in HIV negative patients with cardiovascular disease which was associated with adverse cardiovascular events, however patients with HIV on ART showed lower immature platelet function <sup>5</sup>. The study concluded that a reduction in IPF could only be obtained with administration of ART in the absence of cardiovascular disease and that the presence of cardiovascular disease hindered any significant reduction in IPF, however the researchers of this study suggested a future investigation to be done to determine if an increased IPF can be used as a biomarker for predicting adverse cardiovascular events in HIV patients. If patients present with an enlarged IPF, this biomarker could serve as a protective warning sign against a potential adverse cardiovascular event.

### **Hypothesis/Specific Aims/Research Questions**

Numerous research data has suggested that HIV prevalence is associated and positively correlated with cardiovascular disease deaths, but little has been done to suggest how HIV status affects the outcome of cardiovascular disease. I hypothesize a positive correlation between HIV

prevalence and deaths from cardiovascular disease by way of HIV exacerbating cardiovascular disease thereby outlining a cause and effect. Additionally I hypothesize a difference in cardiovascular disease prognosis between male and female gender.

## **Methods**

### *Context/Protocol*

I utilized data from human subjects that was already available on the CDC wonder public data set.

### *Data Collection*

In order to investigate the effect HIV status and gender has on cardiovascular disease outcome, I collected data on 3 variables: HIV prevalence, gender, and cardiovascular disease deaths in all US states and territories. HIV prevalence was available on the NCHHSTP AtlasPlus data on HIV prevalence between 2014 and 2016 for ages 13 years and older for all races, sexes, and transmission categories. I collected cardiovascular disease death data and the gender for the corresponding data set on the Interactive Atlas of Heart Disease and Stroke for all US states and territories. The three variables I will analyze will be number of cases of HIV in each US state or dependent area compared to number of deaths due to cardiovascular disease in that same US state or dependent area compared to gender.

### *Data Analysis*

A linear regression test paired the HIV prevalence and cardiovascular disease deaths data to assess for a correlation between HIV prevalence and cardiovascular disease deaths. A p-value of less than .05 was considered statistically significant and suggested that HIV status has been

observed to worsen the prognosis of cardiovascular disease. The linear regression test assessed for a correlation between gender and cardiovascular disease deaths. The data was inputted such that males had a numerical value of 1 and females had a numerical value of 2. A p-value of less than .05 was again considered statistically significant and suggested that cardiovascular disease is exacerbated by the gender given the higher numerical value: female, in this study.

## Results

| <b>Table 1: Cardiovascular Disease Deaths, HIV Prevalence, and Gender descriptive statistics</b> |             |                           |                        |
|--|-------------|---------------------------|------------------------|
| <b>Category</b>  | <b>Mean</b> | <b>Standard Deviation</b> | <b>Sample Size (N)</b> |
| <b>Cardiovascular Disease Deaths</b>   | 441.07      | 120.45                    | 112                    |
| <b>HIV Prevalence</b>  | 308.37      | 421.06                    | 112                    |
| <b>Gender</b>  | 1.5         | .50225                    | 112                    |

Table 1 lists the descriptive statistics given by the linear regression analysis. Of the 112 samples, the mean number of cardiovascular disease deaths was 441.07 per US state or region. The mean number of HIV cases in each state or region was 308.37. Finally, the mean value of gender was 1.5, between males having a value of 1 and females having a value of 2, indicating equal representation of male and female sample data.

| <b>Table 2: Correlations between Cardiovascular Disease Deaths, HIV Prevalence, and Gender</b> |                                      |                       |               |
|--|--------------------------------------|-----------------------|---------------|
| <b>Category</b>  | <b>Cardiovascular Disease Deaths</b> | <b>HIV Prevalence</b> | <b>Gender</b> |
| <b>Cardiovascular Disease Deaths</b>   | 1.00                                 | .27                   | -.68          |
| <b>HIV Prevalence</b>  | .27                                  | 1.00                  | -.37          |
| <b>Gender</b>  | -.68                                 | -.37                  | 1.00          |

Table 2 states the correlation values obtained by the linear regression analysis.

Cardiovascular disease deaths had a correlation of .27 with HIV prevalence and a -.68 correlation with Gender. HIV prevalence had a -.37 correlation with Gender.

| <b>Table 3: Linear Regression Results for HIV Prevalence and Gender vs Cardiovascular Disease Deaths</b> |                |                       |                                       |
|--|----------------|-----------------------|---------------------------------------|
| <b>Category</b>  | <b>B value</b> | <b>Standard Error</b> | <b>Significance value (alpha=.05)</b> |
| <b>HIV Prevalence</b>  | .006           | .022                  | .77                                   |
| <b>Gender</b>  | -161.85        | 18.05                 | .00                                   |

Table 2 lists the B values obtained by the linear regression analysis. HIV prevalence was not shown to have a statistically significant value at .006. Gender was shown to have a statistically significant value of -161.85.



## Discussion

Although Table 2 demonstrates a positive correlation between HIV prevalence and cardiovascular disease deaths, the correlation is small and the B value of .006 is deemed statistically insignificant by the set alpha value of .05. The minor interpretation to be made is that for every new case of HIV, the mean number of cardiovascular disease deaths that rise is approximately 0.006 per thousand. The more significant finding of this study was highlighted by B value of the gender vs cardiovascular disease deaths analysis. Using an alpha of 0.05, it was found to be statistically significant with a value of -161.85. This indicated that for every point increase in gender, going from male to female, the number of cardiovascular disease deaths decreased by approximately 161.85 cases per thousand. This result contradicts much of the literature that suggest women having a higher risk of developing cardiovascular disease than men such as in the earlier mentioned study in which HIV positive women had twice the likelihood of HIV positive men in developing a worse cardiovascular outcome <sup>2</sup>. Upon further investigation however, there has been evidence to suggest that estrogen can be attributed as the protective factor in women. A study conducted on the gender differences in coronary heart disease found that women tend to develop cardiovascular disease 7 to 10 years later than men but women who had an endogenous estrogen deficiency had a sevenfold increase in coronary artery disk risk. Estrogen was claimed to have a protective factor against heart disease due to its regulatory effect on lipids, inflammatory markers, and the coagulant system in addition to its direct vasodilatory effects through the alpha and beta receptors in the vessel wall <sup>6</sup>. An additional study attributed estrogen's cardioprotective results to its interaction with the E2 receptor. In this study, heart failure and ischemic heart injury were linked to bioenergetic abnormalities such as mitochondrial homeostasis. The estrogen

activated E2 receptor can trigger transcriptional changes in nuclear and mitochondrial genes to positively influence mitochondrial function and cell survival thereby offering cardio-protection<sup>7</sup>. Although this is a preliminary finding, if further investigation confirms the protective role of estrogen, then the potential exists for artificial estrogen to stimulate the E2 receptor and protect the population with risk factors for cardiovascular disease or those with a bad prognosis of cardiovascular disease.

## **Conclusion**

Although the results of this study conclude that HIV does not affect cardiovascular disease prognosis and that women have a more favorable prognosis with cardiovascular disease prognosis, the design of the study faces limitations thereby preventing these results from being definitive. The linear regression test used means that the data used pertained to an entire state rather than a single person. Therefore, the same patients who were diagnosed with HIV were not necessarily the same patients who died from or survived cardiovascular disease or were even diagnosed with it. This means that there could still be a causal effect between HIV and cardiovascular disease, as the literature suggest. Furthermore, gender may also not affect cardiovascular disease due to the same limitation of a linear regression test. Future studies should be conducted in order to further investigate these potential relationships between HIV with cardiovascular disease and gender with cardiovascular disease. Much of the literature seems to suggest an association between HIV and cardiovascular disease, and if a true causal relationship can be established, it may necessitate cardiovascular disease preventative measures. Additionally, if a relationship between gender and cardiovascular disease can be causally established, the vulnerable gender can also be given subsequent

cardioprotective measures. With these additional steps, numerous cases of cardiovascular disease can be prevented.

## References

1. Capotosto L, D'Ettorre G, Ajassa C, et al. Assessment of Biventricular Function by Three-Dimensional Speckle Tracking Echocardiography in Adolescents and Young Adults with Human Immunodeficiency Virus Infection: A Pilot Study. *Cardiology*. October 2019:1-11. doi:10.1159/000503140
2. Kentoffio K, Albano A, Koplan B, et al. Electrocardiographic Evidence of Cardiac Disease by Sex and HIV Serostatus in Mbarara, Uganda. *Glob Heart*. October 2019. doi:10.1016/j.gheart.2019.08.007
3. Jung H, Yang P-S, Jang E, et al. Prevalence and Associated Stroke Risk of Human Immunodeficiency Virus-Infected Patients With Atrial Fibrillation — A Nationwide Cohort Study —. *Circ J*. October 2019. doi:10.1253/circj.CJ-19-0527
4. Quiles N, Taylor BS, Ortiz A. Effectiveness of an 8-week aerobic exercise program on autonomic function in people living with HIV taking Anti-retroviral therapy: A pilot randomized controlled trial. *AIDS Res Hum Retroviruses*. October 2019. doi:10.1089/aid.2019.0194
5. Goedel A, Müller S, Schwerdtfeger C, et al. Influence of antiretroviral therapy and cardiovascular disease on the immature platelet fraction in patients living with HIV. *Platelets*. October 2019:1-7. doi:10.1080/09537104.2019.1678114
6. Maas AHM, Appelman YEA. Gender differences in coronary heart disease. *Neth Heart J*. 2010;18(12):598-602. doi:10.1007/s12471-010-0841-y
7. Iorga A, Cunningham CM, Moazeni S, Ruffenach G, Umar S, Eghbali M. The protective

role of estrogen and estrogen receptors in cardiovascular disease and the controversial use of estrogen therapy. *Biol Sex Differ.* 2017;8(1):33. doi:10.1186/s13293-017-0152-8