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Age, Gender, and Racial Differences between Acute Myocardial Infarction, Type 2 Diabetes, and their Comortality

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Abstract

Acute myocardial infarction and type two diabetes are within the top seven causes of death in the United States and their impact on society is costly. Although there are many studies conducted about these diseases, some of the research is aged and requires more recent datasets. The objective of this research is to revel trends in these diseases, as well as in their comorbidity, relating to age, gender, and race. To conduct this research, data has been collected from the CDC Wonder dataset using their comorbidity database. This comorbidity data uses USA death certificates from 1999-2017 to retrieve the medical information from each state. The data pulled was then analyzed using two SPSS tests, ANOVA and independent T test, to discern significance and visualize trends. Data from the two ANOVA tests and one independent T test involving type two diabetes and acute myocardial infarction shows statistically significant differences regarding mortality involving those age 65+ as well as persons identifying as White or Black/African American. Using the same tests to analyze type two diabetes reveals significant differences regarding mortality involving those age 65+ or identifying as Asian/Pacific Islander. Finally, results from the two ANOVA tests and the independent T test analyzing the co-mortality of acute myocardial infarction and type two diabetes showed a significant difference in mortality for those age 65+ or identifying as Asian/Pacific Islander.

Key Words: Type 2 Diabetes, Acute Myocardial Infarction, Comortality, Age, Race, Gender

Introduction/Literature Review

Acute myocardial infarction and type two diabetes are within the top seven causes of death in the United States and their impact on society is costly. The objective of this research is to investigate the connection between age, gender, and race and comorbidity of type 2 diabetes and acute myocardial infarction. In this introduction, we first identify the existing literature of type 2 diabetes and acute myocardial infarction separately, then discuss comortality of these diseases, ending with identifying gaps in the literature and how our study begins to address these gaps.

Type 2 Diabetes

Type 2 diabetes is a disease defined by the interaction between the body and glucose. When nutrients are consumed and absorbed, glucose enters the bloodstream and begins to move into the tissues and organs of the body, supplying them with energy to carry out basic metabolic processes. The absorption of glucose from the blood to tissues is where the mechanism of type 2 diabetes can be found. Glucose is normally absorbed into cells through glucose transporters and one of the insulin dependent ones is the GLUT4 transporter. This transporter's presence on the cell surface is determined by insulin signaling. In type 2 diabetes, the insulin signal is not effectively transported and glucose remains in the blood, leading to hyperglycemia and the signs and symptoms of the disease.[1] In a research paper conducted at Appalachia State University, using data collected from the Center for Disease Control, there is existing data showing how both incidence and prevalence of type 2 diabetes increased since 1980.[2] One of the points of this research will be to confirm this trend and show patterns with age and gender to the mortality of type 2 diabetes.

Acute Myocardial Infarction

The term myocardial infarction has been defined differently over the past twenty-one years and with new labs, imaging techniques, and molecular mechanisms being discovered, the definition of the term will continue to change. One of the more recent definitions for myocardial infarction was provided by Dr. Louis Buja from the University of Texas. His definition described five different techniques/subtypes of myocardial infarction including primary atherothrombotic coronary event, sudden cardiac death, and coronary stent thrombosis to name a few.[3] Demographic trends involving mortality from acute myocardial infarction involving race, age, and gender were identified over years of research. Some examples include increased risk for acute myocardial infarction for Native Hawaiians as compared to Caucasians.[4] Age as a variable has also been the focus of many studies, some with conflicting data. One study using the American Heart Association's Coronary Artery Disease national registry found that patients are being diagnosed at younger ages in more recent years.[5] Another study found the opposite, with older populations showing increased prevalence of diagonosis.[6] Gender and its connection with acute myocardial infarction was studied, with some researchers attributing higher mortality rates with males rather than females.[7] Using the CDC Wonder dataset, all of the documented subtypes of myocardial infarction can be searched for and set as a variable under the code UCD-IDC I21. Using this tool, this project aims to understand trends within myocardial infarction as well as its connection to type 2 diabetes.

Comorbidity of Type 2 Diabetes and Acute Myocardial Infarction

Within the top ten causes of death in the US population, heart disease is the leading cause of death and generalized diabetes is ranked seventh.[8] A novel approach to studying these two diseases is analyzing the possibility of shared mortality between them. These two diseases are documented as being connected through comorbidity documentation in hospitals around the world.[9,10] This project plans to understand connections between type 2 diabetes and myocardial infarction in the scope of “mortality” as opposed to “morbidity”. The morbidity of a disease is defined as the condition of having a certain disease whereas mortality is death resulting from the disease. When speaking of comorbidity, the analysis would include subjects who had active diagnoses of both diseases in question. For the definition of co-mortality, based on the CDC Wonder Dataset, the death certificate of the individual must include both of the diagnoses on the document. Connections between type 2 diabetes and acute myocardial infarction have already been researched regarding gender, socioeconomic status, and many other demographics by universities and hospital systems around the globe. One trend is the increased risk of experiencing an acute myocardial infarction if the patient is already diagnosed with type 2 diabetes.[11] This paper will aim to show the connection and certain risk factors these two diseases have across the population of the United States.

Gaps in the Literature

One interesting point while discussing these two diseases is the comorbidity between them. A study from the American Diabetes Association found that the rate for event rate for co-morbidity of major coronary heart disease and type 2 diabetes was markedly increased in comparison to developing coronary heart disease in those without diabetes.[12] Although this research does present a similar objective to this project, there are three key distinguishing factors this project aims to address. First, Dr. Juutilaninen et. al’s research was published in 2004, lending this topic to be readdressed with updated data. Secondly, this research paper will narrow the variable of coronary heart disease to myocardial infarction to provide a more focused topic with less internal variability. And finally, the population studied in Dr. Juutilaninen et. al’s research was 1,375 Finnish natives, whereas this study will analyze the population of recorded deaths across the entire United States of America between the years of 1999 and 2017. With these added parameters and varied methods, we aim to produce data that will show an accurate average trend between the co-mortality of type 2 diabetes and myocardial infarction.

Research Questions

Research questions:

1. How does age affect mortality from type 2 diabetes?
2. How does gender affect mortality from type 2 diabetes?
3. How does race affect mortality from type 2 diabetes?
4. How does age affect mortality from acute myocardial infarction?
5. How does gender affect mortality from acute myocardial infarction?
6. How does race affect mortality from acute myocardial infarction?
7. How does age affect comortality for type 2 diabetes and acute myocardial infarction?
8. How does gender affect comortality for type 2 diabetes and acute myocardial infarction?
9. How does race affect comortality from type 2 diabetes and acute myocardial infarction?

Methods

Context/Protocol

This research was conducted using data collected from humans compiled from the CDC Wonder Database. The CDC Wonder Database collected this mortality information from US death certificates. The Multiple Causes of Death and Detailed Mortality databases collected the mortality data from each county in the US based on death certificates from residents. These certificates included information regarding primary cause of death, additional causes of death, age, place of residence, race, gender, and year. Additional information was available for urban areas which included day of the week, location of death, and autopsy status. The data is collected and updated annually. The data itself is collected by the Vital Statistics Cooperative which includes the following agencies: the U.S. Department of Health and Human Services (US DHHS), Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS), Division of Vital Statistics (DVS), Mortality Statistics Branch.

Data Collection

I collected the data from the CDC Wonder Database. I used the Multiple Causes of Death and the Detailed Mortality databases. The two causes of death specified for this project are Type 2 Diabetes (non-insulin dependent diabetes, UCD-IDC E11) and Acute Myocardial Infarction (UCD-IDC I21). The four parameters I used to create the datasets for each of these diseases were gender, age, race, and years 1999-2017, using data from all 50 states and the District of Columbia. All data available was included except for MI individuals less than 15 years old due to few states reporting this data. Parameters I did not include were specific location and day of the week. I did not include the location parameter in particular to ensure the largest, nationwide view that will standardize any fluctuation between those variables.

Data Analysis

Research questions 1,3,4,6,7, and 9 all aim to analyze the impact of age or race on mortality from type 2 diabetes or acute myocardial infarction. These contain comparison analyses. For example, the first research question focused on comparing different age groups for their mortality to type 2 diabetes. To compare these different groups, I used the ANOVA test to determine if there was a significant difference and then used a Post-hoc test to show which groups in particular were significant. This data was also used to analyze the impact between a certain age range and higher mortality to type 2 diabetes. Descriptive stats will be collected for each of the research questions.

Research questions 2,5, and 8 required a different test because the gender variable only having two available categories. An independent t-test with descriptive analysis was conducted, allowing to compare means and test for a significant difference between the genders. This test was conducted for each of the diseases individually and then using the comortality data.

Results

RQ1: How does age affect mortality from type 2 diabetes?

Three age groups were statistically significantly different when compared to each other age group's mean mortality rate from type 2 diabetes. For each of the age groups of 65-74, 75-84, and 85+, their mean mortality rate from type 2 diabetes (18.40, 43.26, and 92.66, respectively) was statistically significantly higher ($p<.05$) than all the younger age groups and also statistically significantly lower ($p<.05$) than all the older age groups (Table 1). Each of the other, younger age groups were not statistically significantly different in comparison to each other when comparing the mean mortality.

Table 1: Mortality from Type 2 Diabetes based on Age Groups

Age Group	Mean	Standard Deviation
25-34	0.0915[e,f,g]	0.0384
35-44	0.5111[e,f,g]	0.2275
45-54	2.1855[e,f,g]	0.8961
55-64	7.1042[e,f,g]	2.6184
65-74	18.3952[a,b,c,d,f,g]	5.8780
75-84	43.2593[a,b,c,d,e,g]	13.5716
85+	92.6642[a,b,c,d,e,f]	30.8139

[a]Data is statistically significantly different compared to the Mean of the 25-34 Age Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the 35-44 Age Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the 45-54 Age Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the 55-64 Age Group ($p<0.05$)
[e]Data is statistically significantly different compared to the Mean of the 65-74 Age Group ($p<0.05$)
[f]Data is statistically significantly different compared to the Mean of the 75-84 Age Group ($p<0.05$)
[g]Data is statistically significantly different compared to the Mean of the 85+ Age Group ($p<0.05$)

RQ2: How does gender affect mortality from type 2 diabetes?

The means for the mortality rates from type 2 diabetes in males (M=6.2, SD=2.2) and females (M=6.1, SD=2.2) were not statistically significantly different.

RQ3: How does race affect mortality from type 2 diabetes?

The only statistically significant difference in mean mortality rate from type 2 diabetes was from persons identifying as Asian or Pacific Islander (Table 2). Asian or Pacific Islander mortality rate (2.50) was statistically significantly lower than the mortality rate for American Indian or Alaska Native (6.83), Black or African American (5.91), and White (6.06), all at the $p<.05$ level.

Table 2: Mortality from Type 2 Diabetes based on Race		
Race	**Mean**	**Standard Deviation**
American Indian or Alaska Native	6.8269[b]	5.1984
Asian or Pacific Islander	2.4980[a,c,d]	1.4212
Black or African American	5.9133[b]	2.7967
White	6.0637[b]	2.3071

[a]Data is statistically significantly different compared to the Mean of the American Indian or Alaska Native Race Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the Asian or Pacific Islander Race Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the Black or African American Race Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the White Race Group ($p<0.05$)

RQ4: How does age affect mortality from acute myocardial infarction?

Similar to type 2 diabetes, the oldest three age groups were statistically significantly different when compared to each other age group's mean mortality rate from acute myocardial infarction. For each of the age groups of 65-74, 75-84, and 85+, their mean mortality rate from myocardial infarction (122.25, 294.40, and 763.66, respectively) was statistically significantly higher ($p<.05$) than all the younger age groups and also statistically significantly lower ($p<.05$) than all the older age groups (Table 3). Additionally, the mean morality rate for the 25-34 age group (1.08) was also statistically significantly different ($p<.05$) lower than the 55-64 age group (55.75).

Table 3: Mortality from Acute Myocardial Infarction based on Age Groups

Age Group	Mean	Standard Deviation
15-24	0.1802[f,g,h]	0.1263
25-34	1.0845[e,f,g,h]	0.8203
35-44	6.2848[f,g,h]	4.1491
45-54	22.8819[f,g,h]	12.9600
55-64	55.7511[b,f,g,h]	26.4435
65-74	122.2494[a,b,c,d,e,g,h]	43.7817
75-84	294.4009[a,b,c,d,e,f,h]	82.2802
85+	763.6585[a,b,c,d,e,f,g]	206.6589

[a]Data is statistically significantly different compared to the Mean of the 15-24 Age Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the 25-34 Age Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the 35-44 Age Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the 45-54 Age Group ($p<0.05$)
[e]Data is statistically significantly different compared to the Mean of the 55-64 Age Group ($p<0.05$)
[f]Data is statistically significantly different compared to the Mean of the 65-74 Age Group ($p<0.05$)
[g]Data is statistically significantly different compared to the Mean of the 75-84 Age Group ($p<0.05$)
[h]Data is statistically significantly different compared to the Mean of the 85+ Age Group ($p<0.05$)

RQ5: How does gender affect mortality from acute myocardial infarction?

The means for the mortality rates from acute myocardial infarction in males (M=52.6, SD=19.6) and females (M=40.8, SD=14.7) were not statistically significantly different ($p>.05$).

RQ6: How does race affect mortality from acute myocardial infarction?

Two racial categories were identified as being statistically significantly different when comparing the mean morality rates form acute myocardial infarction (Table 4). Black or African American persons experienced a statistically significantly higher mean (27.43) than both the American Indian or Alaska Native (17.40) and the Asian or Pacific Islander (11.10) groups while having a statistically significantly lower mean than the White group (49.81), all at the $p<.05$ level. The White demographic also showed a statistically significantly higher mean mortality rate than each of the other racial categories ($p<.05$).

Table 4: Mortality from Acute Myocardial Infarction based on Race		
Race	**Mean**	**Standard Deviation**
American Indian or Alaska Native	17.4014[c,d]	10.2503
Asian or Pacific Islander	11.1037[c,d]	5.1340
Black or African American	27.4259[a,b,d]	17.4220
White	49.8063[a,b,c]	18.4662

[a]Data is statistically significantly different compared to the Mean of the American Indian or Alaska Native Race Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the Asian or Pacific Islander Race Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the Black or African American Race Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the White Race Group ($p<0.05$)

RQ7: How does age affect comortality for type 2 diabetes and acute myocardial infarction? The oldest two age groups (75-84 and 85+) were statistically significantly different when comparing the mean comortality rates to each other younger age group (Table 5). The mean comortality rate for the 75-84 age group (16.60) and 85+ age group (28.57), was statistically significantly higher ($p<.05$) than all the younger age groups and also statistically significantly lower ($p<.05$) than all the older age groups. The mean comortality rate for the 65-74 age group (7.99) was statistically significantly different to each group except the 25-34 age group (0.02), being significantly higher ($p<.05$) than all the younger age groups and significantly lower than the older age groups ($p<.05$). None of the means collected from the age groups between 25-64 were statistically significantly different when comparing them to each other.

Table 5: Comortality between Type 2 Diabetes and Acute Myocardial Infarction based on Age Groups		
Age Group	**Mean**	**Standard Deviation**
25-34	0.0243[f,g]	0.0020
35-44	0.1877[e,f,g]	0.0991
45-54	0.9778[e,f,g]	0.4433
55-64	3.2401[e,f,g]	1.4118
65-74	7.9909[b,c,d,f,g]	2.9624
75-84	16.5954[a,b,c,d,e,g]	5.7503
85+	28.5697[a,b,c,d,e,f]	10.7180

[a]Data is statistically significantly different compared to the Mean of the 25-34 Age Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the 35-44 Age Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the 45-54 Age Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the 55-64 Age Group ($p<0.05$)
[e]Data is statistically significantly different compared to the Mean of the 65-74 Age Group ($p<0.05$)
[f]Data is statistically significantly different compared to the Mean of the 75-84 Age Group ($p<0.05$)
[g]Data is statistically significantly different compared to the Mean of the 85+ Age Group ($p<0.05$)

RQ8: How does gender affect comortality for type 2 diabetes and acute myocardial infarction? The mean comortality rates for these two diseases between males (M=2.7, SD=1.1) and females (M=2.1, SD=0.9) were not statistically significantly different.

RQ9: How does race affect comortality from type 2 diabetes and acute myocardial infarction? The only statistically significant difference in mean mortality rate from the comortality of type 2 diabetes and acute myocardial infarction was for persons identifying as Asian or Pacific Islander (Table 6). Mean comortality rate for Asian or Pacific Islander (.89) was significantly lower ($p<.05$) compared to American Indian or Alaska Native (2.52), Black or African American (2.00), and white (2.43) racial groups.

Table 6: Comortality between Type 2 Diabetes and Acute Myocardial Infarction based on Race		
Race	**Mean**	**Standard Deviation**
American Indian or Alaska Native	2.5229[b]	1.5062
Asian or Pacific Islander	0.8859[a,c,d]	0.5878
Black or African American	1.9975[b]	0.9725
White	2.4319[b]	1.0693

[a]Data is statistically significantly different compared to the Mean of the American Indian or Alaska Native Race Group ($p<0.05$)
[b]Data is statistically significantly different compared to the Mean of the Asian or Pacific Islander Race Group ($p<0.05$)
[c]Data is statistically significantly different compared to the Mean of the Black or African American Race Group ($p<0.05$)
[d]Data is statistically significantly different compared to the Mean of the White Race Group ($p<0.05$)

Discussion

The connection between mortality stemming from type 2 diabetes and ageing was hypothesized to be a direct relationship, showing increasing in age matched with an increasing mortality from type 2 diabetes. The results from this study confirmed this hypothesis with an increase in mortality rates for patients who were 65 years old and older (Table 1). Advancing in age can increase the susceptibility of a patient to many disease processes and type 2 diabetes is one of the diseases which shows increased mortality with increasing age. In the Diabetes and Aging study conducted by Dr. Huang et al., the longer a patient was diagnosed with type 2 diabetes, the higher the mortality rate. In the same study, it was found that the age of the patient was also directly correlated with the mortality rate from type 2 diabetes.[13] Confirming this study impresses the importance of keeping the age of patients living with type 2 diabetes in mind while formulating effective care and management for the individual.

Another variable that can change the progression and mortality of diseases is gender and there is mixed data revolving around its effects on mortality from type 2 diabetes. In this study, the independent t-test did not show a connection between a certain gender and higher mortality rates form type two diabetes. Even without statistical significance analysis, the mean death rates were surprisingly similar (RQ2). Some literature surrounding gender and its effects on type 2 diabetes has shown a connection between the female gender and increased total mortality from the disease.[14] These mixed findings on a possible connection between type 2 diabetes mortality rate and gender demonstrates the need for additional research and clinical intrigue so healthcare professionals can better serve their patients.

Race and its connections with diseases is a clinically significant research topic and its connection to type 2 diabetes continues to support that claim. This research shows a connection between a lower mortality rate from type 2 diabetes and patients identifying as being of Asian descent (Table 2). Current research also supports this claim, with a United States study conducted by Dr. Lee et al. stating that Asians with diabetes have a lower mortality rate than Whites with diabetes.[15] Clinicians may be able to use this information to bolster risk evaluation techniques with patients who identify as member of a racial group.

Moving towards the literature surround myocardial infarction, there is data supporting its connection with the ageing process. In a study conducted by Dr. Zhang et al., as patients continued to age, their prognosis worsen and mortality rates increased.[16] The results from the ANOVA analysis in this research supports the notion that as patients age beyond the 65 year old threshold, the mortality rates from myocardial infarction also continue to increase (Table 3). Clinical application of these trends should show increased concern and attention to those patients whose age puts them at a potentially higher risk of mortality from myocardial infarction.

As with type 2 diabetes, there exists literary disagreements over a possible connection between increased mortality rates from myocardial infarction and gender. Research conducted by Dr. Canto et al. analyzing both age and gender found that younger women were at a higher risk for mortality due to myocardial infarction, but as patient's age increased, the male rate of mortality increased.[17] In contrast, the results of this project indicated no statistical evidence to show that males or females were at risk for a higher mortality rate. It should be noted that out of the three gender analyses conducted for this paper, the mean mortality rates for myocardial infarction alone between the two genders were the most different (RQ5). Although gender might not have statistically significant findings in this study, more research should be conducted to provide more evidence for this research question.

Racial differences in the mortality from myocardial infarction has been a topic of research in many studies and the results depend largely on sample size, geography, and sampling method. In this research, it was shown that being African American or White increases the mortality rate of myocardial infarction as compared to Asian or American Indian (Table 4). It should also be noted that a difference was found between African American and White mortality rates, showing that the mortality rate for the White population was significantly higher than the African American population (Table 4). Research conducted by Dr. Zhang et al. lends some support and further insight into this argument from their study in 2016, showing that patients of White racial identification had a higher clinical manifestation rate of myocardial infarction. Although, another finding from the study showed those of Black identification having a non-statistically significant higher rate of non-clinically documented myocardial infarction.[18] Elucidating the difference between incidence rates of subclinical and clinical myocardial infarction is out of the scope for this study, but the differences between the rates should be taken into consideration. These studies lend support for clinicians to add or stress racial risk as a part of the identification, prevention, and treatment of myocardial infarction.

The comortality from type 2 diabetes and myocardial infarction has been researched before and the results have correlated with the effects of age on each of the diseases individually. In a study conducted by Dr. Zoungas et al., diabetes and age were associated with higher rates of macrovascular events (such as myocardial infarction) and death from those events.[19] The research in this paper supports these findings, showing an increase in mortality rate as a patient age rises above the 65 year mark (Table 5). There was a slight discrepancy in the statistically significant findings between the 65-74 and 25-34 age groups but this I believe to be a computing error by the ANOVA system, considering the mean mortality rates were 7.99 and 0.02 respectively. For patients aged 65+, there is evidence that suggests clinicians should address the risk of comortality between these diseases and modulate the care of their patients accordingly.

Gender and its effect on the comortality from type 2 diabetes and myocardial infarction presents with similar uncertainty in the literature as with each of the disease individually. Dr. Lee et al. conducted research which showed a possibly lower mortality rate in men from type 2 diabetes and coronary heart disease (such as myocardial infarction) and a non-statistically significant increased mortality risk for women.[20] The research conducted in this paper also showed inconclusive evidence that one of the genders experienced a higher mortality rate from both of the diseases (RQ8). Although there is conflicting evidence over the impact of gender on the comortality of these two diseases, the topic still should remain a point of discussion and further research with clinical researchers and medical professionals.

The connection between race and the comortality from type 2 diabetes and acute myocardial infarction has been studied in the scientific community and the results of some of their research papers match the results from this study. In a study conducted by Dr. Ma et al., there was evidence to show that persons of Asian dissent had a lower risk of coronary heart disease than their European counterparts.[21] Another study conducted by Dr. Raffield et al. found that persons identifying as European American had an increased risk of cardiovascular disease mortality.[22] the research from this study shows similar results, with those of Asian American identification showing a decreased mortality rate from the comortality of these diseases (Table 6). Race should be another possible risk factor to be discussed and accounted for when working with patients who have comorbidity between type 2 diabetes and myocardial infarction.

Conclusion

Analyzing the mortality between type 2 diabetes and acute myocardial infarction can provide insightful discovers about risk but it can also present problems and limitations depending on what source data is used. A strength of this research is through using the CDC Wonder datasets, Multiple Causes of Death and Detailed Mortality, a large population was able to be analyzed over 18 consecutive years. A limitation with is data could be the accuracy and pervasive use of death certificates. Multiple causes of death might not have been identified on the death certificates and there may be undocumented deaths not accounted for, leading to skewed data. The data from this study still provides perspective into this continually evolving field of research and futures directions in this research could include: looking into the mechanism of action that connect type 2 diabetes and acute myocardial infarction, statistically supporting other risk factors, identifying health disparities in treatment, and looking at the comorbidity of the two diseases. This research paper shows how certain age, gender, and racial identifications can affect the mortality rates from type 2 diabetes, acute myocardial infarction, and the comortality between them.

References

1. Ingle, Pravinkumar, et al. Current Trends in Pharmacological Treatment of Type II Diabetes Mellitus. *International Journal of Pharma Research and Review*. Jan 2018;7(1):1-15.

2. Robinson Matthew, Turner Caroline. Incidence and Prevalence of Type 2 Diabetes in America: Is There Culpability in the Food Industry? *State Crime Journal*. 2019;8(2):175. doi:10.13169/statecrime.8.2.0175

3. Buja LM, Zehr B, Lelenwa L, et al. Clinicopathological complexity in the application of the universal definition of myocardial infarction. *Cardiovasc Pathol*. 2020;44:107153. doi:10.1016/j.carpath.2019.107153

4. Lim E, Cheng Y, Reuschel C, et al. Risk-Adjusted In-Hospital Mortality Models for Congestive Heart Failure and Acute Myocardial Infarction: Value of Clinical Laboratory Data and Race/Ethnicity. *Health Serv Res*. 2015;50(S1):1351-1371. doi:10.1111/1475-6773.12325

5. Shah B, Bangalore S, Gianos E, et al. Temporal trends in clinical characteristics of patients without known cardiovascular disease with a first episode of myocardial infarction. *Am Heart J*. 2014;167(4):480-488.e1. doi:10.1016/j.ahj.2013.12.019

6. Plakht Y, Abu Eid A, Gilutz H, Shiyovich A. Trends of Cardiovascular Risk Factors in Patients With Acute Myocardial Infarction: Soroka Acute Myocardial Infarction II (SAMI II) Project. *Angiology*. 2019;70(6):530-538. doi:10.1177/0003319718816479

7. Ioacara S, Popescu AC, Tenenbaum J, et al. Acute myocardial infarction mortality rates

and trends in Romania between 1994 and 2017. *Int J Environ Res Public Health*. 2020;17(1). doi:10.3390/ijerph17010285

8. FastStats - Leading Causes of Death. https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm. Accessed February 3, 2020.

9. Afanasiev SA, Garganeeva AA, Kuzheleva EA, Andriyanova AV, Kondratieva DS, Popov SV. The Impact of Type 2 Diabetes Mellitus on Long-Term Prognosis in Patients of Different Ages with Myocardial Infarction. Journal of Diabetes Research. July 2018:1-6. doi:10.1155/2018/1780683

10. de Miguel-Yanes JM, Jiménez-García R, Hernández-Barrera V, Méndez-Bailón M, de Miguel-Díez J, Lopez-de-Andrés A. Impact of type 2 diabetes mellitus on in-hospital-mortality after major cardiovascular events in Spain (2002-2014). Cardiovascular diabetology. 2017;16(1):126. doi:10.1186/s12933-017-0609-4

11. Huxley R, Barzi F, Woodward M. Excess risk of fatal coronary heart disease associated with diabetes in men and women: Meta-analysis of 37 prospective cohort studies. *Br Med J*. 2006;332(7533):73-76. doi:10.1136/bmj.38678.389583.7C

12. Juutilainen A, Kortelainen S, Lehto S, Onnemaa TR¨. *Gender Difference in the Impact of Type 2 Diabetes on Coronary Heart Disease Risk*.; 2004.

13. Huang ES, Laiteerapong N, Liu JY, John PM, Moffet HH, Karter AJ. Rates of complications and mortality in older patients with diabetes mellitus: the diabetes and aging study. JAMA Internal Medicine. 2014;174(2):251-258. doi:10.1001/jamainternmed.2013.12956

14. Kautzky-Willer A, Harreiter J. Sex and gender differences in therapy of type 2 diabetes. *Diabetes Res Clin Pract*. 2017;131:230-241. doi:10.1016/j.diabres.2017.07.012

15. Lee JR, Yeh H-C. Trends in the prevalence of type 2 diabetes and its association with mortality rates in Asians vs. Whites: Results from the United States National Health Interview Survey from 2000 to 2014. *J Diabetes Complications*. 2018;32(6):539-544. doi:10.1016/j.jdiacomp.2018.04.001

16. Zhang Z, Fang J, Gillespie C, Wang G, Hong Y, Yoon PW. Age-Specific Gender Differences in In-Hospital Mortality by Type of Acute Myocardial Infarction. *Am J Cardiol*. 2012;109(8):1097-1103. doi:10.1016/j.amjcard.2011.12.001

17. Canto JG, Rogers WJ, Goldberg RJ, et al. *ORIGINAL CONTRIBUTION Association of Age and Sex With Myocardial Infarction Symptom Presentation and In-Hospital Mortality*. www.jama.com. Accessed April 5, 2020.

18. Zhang Z, Rautaharju P, Prineas R, Circulation CR-, 2016 undefined. Race and sex differences in the incidence and prognostic significance of silent myocardial infarction in the Atherosclerosis Risk in Communities (ARIC) Study. *Am Hear Assoc*. https://www.ahajournals.org/doi/abs/10.1161/CIRCULATIONAHA.115.021177. Accessed April 6, 2020.

19. Zoungas S, Woodward M, Li Q, et al. Impact of age, age at diagnosis and duration of diabetes on the risk of macrovascular and microvascular complications and death in type 2 diabetes. *Diabetologia*. 2014;57(12):2465-2474. doi:10.1007/s00125-014-3369-7

20. Lee C, Joseph L, Colosimo A, Dasgupta K. Mortality in diabetes compared with previous cardiovascular disease: a gender-specific meta-analysis. *Diabetes Metab*. 2012;38(5):420-

427. doi:10.1016/j.diabet.2012.04.002

21. Ma RCW, Chan JCN. Type 2 diabetes in East Asians: Similarities and differences with populations in Europe and the United States. *Ann N Y Acad Sci*. 2013;1281(1):64-91. doi:10.1111/nyas.12098

22. Raffield LM, Cox AJ, Criqui MH, et al. Associations of coronary artery calcified plaque density with mortality in type 2 diabetes: the Diabetes Heart Study. *Cardiovasc Diabetol*. 2018;17(1):67. doi:10.1186/s12933-018-0714-z