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Diabetes Link to Social Determinants of Health

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Population & Public Health Track

Scholarship in Medicine Proposal

☒ **By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission (I am in the Fall Super Short Course with Dr. Todd)**

Abstract

Objective: The purpose of this paper is to investigate diabetes and how premature death rate; income inequality and social associations relate to diabetes prevalence in the state of Washington in 2020. *Methods:* I investigated the rate of diabetes change in Washington from 201 to 2020 using a paired t-test. The correlation of diabetes rates and the premature age-adjusted mortality was calculated by county in Washington in 2020 using a Pearson/Spearman correlation. I compared the rate of diabetes in Washington to South Carolina, Ohio, and Louisiana by county in 2020 using an ANOVA with posthoc. Lastly, I used a stepwise linear regression to see how rates of income inequality, social associations, and children in poverty predict rates of diabetes in Washington counties in 2020 *Results:* (TBD).

Key Words: (Washington, Diabetes, Socioeconomic Status, Children in Poverty)

Introduction/Literature Review

Diabetes mellitus is a serious life altering disease that increased in prevalence by 2.5% in the United States in the past 20 years and is projected to increase by roughly 54% from 2015 to 2030.[1,2] As of 2018 roughly 34.2 million people are estimated to have diabetes in the United States.[1] Diabetes is divided in to two types: type 1 diabetes mellitus (T1DM) is the often inherited inability to make insulin due to autoimmune destruction of pancreatic beta cells, and type 2 diabetes mellitus (T2DM) is an often acquired combination of insensitivity to and deficiency of insulin.[3] T2DM is much more common at 90.9%, while the prevalence of type 1 is 5.8%.[4]

Diabetes is deadly, taking seventh place in 2017 as leading cause of death in the United States.[1] The cost is also tremendous, both direct and indirect estimated to be $237 billion and $90 billion respectively, with excess medical costs per person of $9,601.[1] The consequences are severe both to health and finances, but a majority of diabetes cases can be prevented. T2DM is not only the most common, but preventable with the right lifestyle choices.[3] Socioeconomic economic status (SES) in terms of education may play a role in these choices, as different education levels have a statistically different prevalence by 5.8% (lower education has a higher prevalence).[1] Additionally, lower SES early in life is a risk factor for concurrent and future[5,6] poor health outcomes. However, data linking certain social health determinants to diabetes are lacking.

In this study I will investigate the rate of change of diabetes in the state of Washington by county from 2010 to 2020; correlate the rate of diabetes by county in Washington to premature age-adjusted mortality; compare the rate of diabetes in Washington to that of South Carolina, Ohio, and Louisiana; and assess how rates of income inequality, social associations and children in poverty account for the variance in diabetes in Washington counties in 2020.

Research Questions

RQ1: How has rate of diabetes changed by county in Washington from 2011 to 2020?

RQ2: How does rate of diabetes correlate with rate of premature age-adjusted mortality by county in Washington in 2020?

RQ3: How does rate of diabetes in Washington compare to South Carolina, Ohio, and Louisiana by county in 2020?

RQ4: How do rates of income inequality, social associations, and children in poverty account for the variance in diabetes in Washington counties in 2020?

Methods

Context and Data Collection

Aggregate data was previously collected and disseminated by County Health Rankings[7]. Five variables were used: diabetes, premature death, income inequality, social associations, and children in poverty. All data is from the 2020 County Health Rankings and the actual dates of data collection were included per variable. No data was excluded because no data was missing.

Diabetes prevalence (both type 1 and 2) was provided by the CDC Interactive Diabetes Atlas, which collected data via phone surveys. Three years of survey data were used to estimate a single-year (2016) prevalence using statistical modeling. The data reports prevalence of respondents age 20 and older by county in the states of Washington, South Carolina, Ohio and Louisiana.

Premature death was collected by the National Center for Health Statistics and reported as age-adjusted years of potential life lost (YPLL) before age 75 per 100,000 and from 2016 to 2018. All of YPLL over the course of the three-year period were tallied and divided by the population of each county, then multiplied by 100,000. Deaths included in this report were linked to the county lived in, not the location of death. Any county with less than 20 deaths in the three-year time frame were reported as a missing value. This data was reported by county in Washington.

Income inequality data were collected by the American Community Survey and reported as a ratio of household incomes in the 80^{th} percentile to the 20^{th} percentile from 2014 to 2018. The higher the ratio the greater the division between the highest and lowest income. The median household income was used to determine the percentiles per county. Income reported was not limited and included all possible forms.

Social associations data were collected by County Business Patterns in 2017 and measure the number of membership associations per 10,000 people. The number of associations was divided by the people at risk during the same time period. This data was reported by county in Washington.

Children in poverty data were collected by the US Census Bureau Small Area Income and Poverty Estimates. The data include people under 18 living in a home with an income below the poverty line. The poverty threshold was determined by the following characteristics: number of people in the household, number of related children under 18, and the primary householder over the age 65. Five years (2014-2018) of data were included to calculate a single-year estimate using statistical modeling. This data was reported by county in Washington.

Data Analysis

All data were analyzed using SPSS[8]. The rate of diabetes change by county in Washington from 2011 to 2020 was computed with a paired t test (RQ1). The rate of diabetes was correlated with rate of premature age-adjusted mortality by county in Washington in 2020 using a Pearson/Spearman correlation (RQ2). The rate of diabetes in Washington was compared to South Carolina, Ohio, and Louisiana by county in 2020 using an ANOVA with posthoc (RQ3). Lastly, we wanted to see how rates of income inequality, social associations, and children in poverty accounted for diabetes in Washington counties in 2020 using a stepwise linear regression (RQ4).

Timeline of your involvement in the project

I am in the 2020 Fall short course with Dr. Todd. We will be submitting our proposal in early September, analysis in mid-September, and finishing the final project by November 2020**.** I plan to present at the Medical Student Research Symposium (online format).

Expected Outcomes

For RQ1, I expect the rate of diabetes in Washington to increase form 2011 to 2020 as is consistent with the national and global trends[1].

For RQ2, I expect the rate of diabetes to strongly correlate with premature age-adjusted mortality in Washington in 2020 because it is a leading cause of death[1]. I expect and increased premature mortality to correlate to increased rates of diabetes.

The states chosen for RQ3 were meant to represent the three coastal regions (West, East, and South) as well as the Midwest in 2020. I expect the southern states of South Carolina and Louisiana to have higher rates of diabetes, followed by Ohio then Washington. If there are variations in diabetes rates amongst the four states, further investigation would be warranted.

Based on evidence linking lower SES to poor health outcomes[5,6], I expect income inequality, social associations, and children in poverty to significantly predict the rates diabetes in Washington in 2020 (RQ4). I expect higher income inequality, lower social associations and more children in poverty to lead to increased rates in diabetes.

Results

The prevalence of diabetes in Washington counties was significantly increased from 8.73% in 2011 to 10.21% in 2020 (t = -7.278, p < .001) (Table 1) (RQ1).

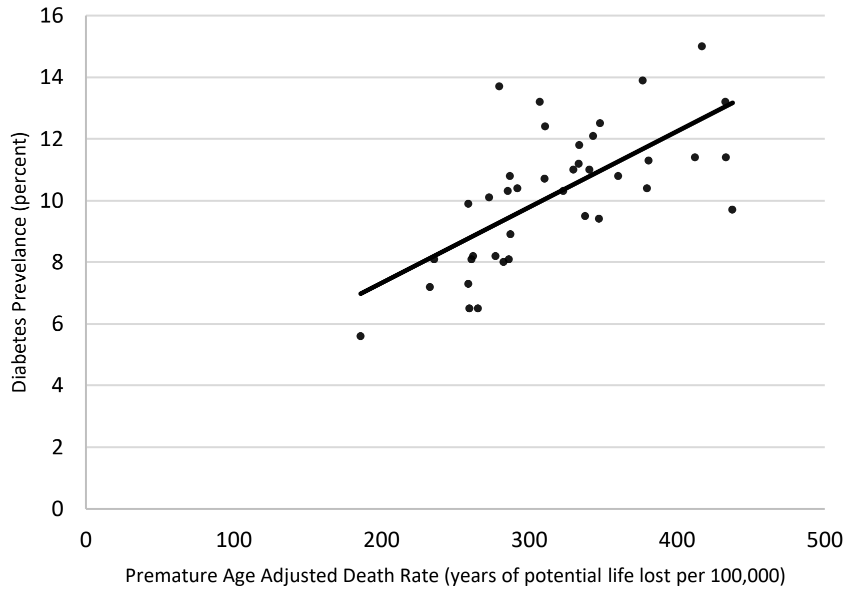
Table 1: Diabetes Prevalence in Washington (RQ1)

Year	**n**	**Mean**	**SD**
2011	39	8.73%	1.56%
2020	89	10.21%[a]	2.21%

Abbreviation: SD, Standard Deviation
[a]statistically significantly different from 2011 (p < .001)

Diabetes rates were correlated to premature age adjusted death rate using a Pearson correlation (RQ2). A moderate but significant correlation (r =.672, p <.001) (Figure 1) indicates that diabetes rates increase as years of potential life lost increase.

Figure 1: Diabetes Rates Correlated to Premature Age Adjusted Death Rate (RQ2)



The rates of diabetes in four states by counties in 2020 (RQ3) were compared via an ANOVA and found to be significantly different ($F_{2,287}$= 152.65, $p < .001$) (Table 2). Further post hoc tests revealed significantly lower rates (10.21%) of diabetes in Washington than Ohio (12.77%), Louisiana (14.5%), and North Carolina (13.23%) all at the $p < 0.001$ level. Louisiana had significantly higher rates of diabetes than Ohio and North Carolina both at a $p < 0.05$ level.

Table 2: Diabetes Among Four States (RQ3)

State	n	Mean	SD
Ohio	88	12.77% [a]	2.46%
Washington	39	10.21%	2.21%
Louisiana	64	14.5%[a,b,c]	3.92%
North Carolina	100	13.23% [a]	4.36%

Abbreviation: SD, Standard Deviation

[a]statistically significantly different from Washington ($p < .001$)
[b]statistically significantly different from Ohio ($p < .05$)
[c]statistically significantly different from North Carolina ($p < .05$)

Finally, we calculated how rates of income inequality, social associations, and children in poverty account for the variance in diabetes in Washington counties in 2020 (RQ4). The best fitting model of a step wise linear regression indicated significance ($F_{3,35} = 28.18$, $p < .001$), accounting for 40.8% of the variance in diabetes. Percent of children in poverty contributed the most to the model ($B = .627$, $t = 4.951$, $p < .001$) with income inequality ($B = -.276$, $t = -2.197$, $p < .05$) also significantly contributing. Social association rates did not significantly add to the model.

Discussion

The goal of this study was to determine if various social factors related to the rates of diabetes in Washington counties and compare those rates to counties in three other states around the U.S. representing the West, East, and South coasts as well as the Midwest. findings related to other studies. Social associations, income inequality, children in poverty, and premature death were all variables investigated in relation to diabetes.

Type 2 diabetes is by far the most common type, and it is preventable with the right life style choices[3]. Further, a link between SES was previously linked to a higher prevalence of T2DM[1], and a low SES earlier in life may lead to poor future health.[5,6] This study aims to establish a link between more specific categories of SES and diabetes rates. More specific links could help physicians pay more attention to certain demographics in terms of screening and education and prevention.

Unsurprisingly we found a significant increase in diabetes prevalence in Washington counties in the last 9 years by 1.5%. This corresponds with the national trend of increased prevalence.[1,2] We also found that diabetes rates were moderately correlated to premature age-adjusted death rate. Diabetes' several deleterious effects on health was known and this correlation was expected but not previously quantified.[1] A correlation to premature death is important because it highlights the urgency in preventing and even reversing diabetes.

Variation in diabetes rates for each state of interest was partially surprising. I did expect the southern states to have higher rates but did not expect each state to be so different. This begs the question, what is it about each state that could cause such a difference? Future research could investigate income, poverty, health care access and policies compared across state lines and the possible reasons behind potential differences. As we found in this study, income inequality and poverty were linked to higher diabetes rates in Washington. This is likely the case elsewhere.

This study had several limitations. The aggregate data cannot be linked to individuals, and it is impossible to know given the data set what individuals possess one or more of the variables we studied. Data at an individual level would strengthen the correlations between diabetes rates and variables like income inequality or health care coverage. Another limitation is the time frame for each variable. The years selected for data collection did not overlap perfectly due to limitations as to what was provided by county health rankings.

Conclusion

The aim of this study was to quantify and correlate diabetes rates with certain SES categories to better understand and identify risk factors. The correlations found in this study strengthen the need to address said risk factors. Practically, physicians in areas with known income disparities and poverty should educate and screen for diabetes in hopes of prevention.

Role of Student

I am in the short course with Dr. Todd. I am the sole student on this project and will complete all sections of this paper aside from data collection, which was aggregated by a third party to a data site.

Plan for Ethical Approval

This project utilizes publicly available aggregate data, deidentified, and poses no risk to health or privacy. No IRB is required.

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