Influence of Health-Related Social Factors on Delaying Seeking Medical Care due to Cost among Individuals with Diabetes

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Abstract

The study examined the influence of health-related social factors on delaying seeking medical care due to cost among 2,620 individuals with diabetes in the United States. The Integrated Public Use Microdata Series Demographic Survey served as the data source. Delaying seeking medical care because of worry about the cost served as the response variable. The predictor variables were types of diabetes, sex, age, region of residence, and employment status. A combination of Up-sampling and Binary Logistic Regression analyses showed that sex and age were significant predictors of individuals with diabetes delaying seeking medical care due to cost. Female patients had higher odds of delaying seeking medical care than their male counterparts. There were decreasing odds of delaying seeking medical care as age increased. Diabetes type, region, and employment status were not statistically significant predictors at the 0.05 level.

Keywords: Diabetes, Binary Logistic Regression, Up-sampling

Introduction

Diabetes remains a significant public health challenge in the United States, placing a substantial burden on individuals and the healthcare system. Ensuring access to medical care is critical in diabetes care. About 11.6% of the US population, have diabetes (Centers for Disease Control and Prevention [CDC], 2023). The report further indicated that 14.7 of the US population with diabetes were adults. Additionally, the percentage of adults with diabetes increased with age, accounting for 29.2% among those aged 65 years or older (CDC, 2023). The economic impact is equally daunting, with diabetes and its related

complications accounting for billions in healthcare costs annually (American Diabetes Association, 2020). Diabetes is a major cause of other non-communicable health conditions and the seventh leading cause of death in the United States in 2020 (WHO, 2021). Type 1 diabetes is caused by the autoimmune destruction of the beta cells in the pancreas, which produce insulin. Individuals with this condition require insulin to survive. Type 2 diabetes is caused by not only a resistance to insulin, but also a deficiency of insulin (Imperatore et al., 2018).

Income and educational levels have a profound influence on the prevalence of and management of diabetes (Schillinger, 2020). The lower the socioeconomic status, the higher the incidence of the disease and the worse the health outcomes are likely to be. There is also evidence of a relationship between job insecurity or unemployment and an increased incidence or prevalence of diabetes. For example, in the United States, the prevalence of diabetes rose with a decrease in income (Braveman et al., 2010). Generally, with higher income patients are also more likely to have health insurance. Insured patients will have an increased number of office visits compared to patients who are not insured (Kazemian et al., 2019). Further, in 2018, the prevalence of diabetes among U.S. adults with more than a high school education which was higher than the prevalence among those with less than a high school education (CDC, 2020). Furthermore, since 1997, the prevalence of the disease has continued to rise among adults with less than a high school education but decreased for those patients with higher education (CDC, 2023).

Geography is another social factor that contributes to the prevalence of diabetes. Gurka et al. (2018) outlined the differences in diabetes prevalence across regions of the United States. The study observed that the lowest prevalence was seen in New England while the highest was recorded in the East South Central and West North Central. Similarly, the lowest and highest prevalence of diabetes in adults was recorded in New England and East South Central and East North Central respectively (Gurka et al., 2018). The built environment is another social factor that affects diabetes prevalence, as lifestyle behaviors are also influenced by the availability and accessibility of healthy options in the environment (Den Braver et al., 2018). Built environments often have higher walkability related to higher physical activity (Van Holle et al., 2012). Amuda and Berkowitz (2019) suggested that enhancing the physical environment especially encouraging more physical activity and exposure to healthy food retail options may reduce the risk of diabetes.

Despite advances in diabetes diagnostics, treatment, and prevention, patterns of diabetes disparities have not improved (Benoit et al, 2019). Access to medical care is key to effective diabetes management. However, individuals from low socioeconomic backgrounds often encounter barriers to receiving proper care due to the lack of insurance and health literacy (Karagiannis et al., 2023). For example, employer-sponsored high-deductible health plans are associated with delayed care for diabetics (Wharam, Lu et al., 2018). The delay in accessing medical care often results in more acute diabetes

complications, especially for high-risk populations (Wharam, Zhang, et al., 2018). Research has consistently shown that improved access to healthcare services leads to better diabetes management and reduced complications (Norris et al., 2002). For instance, Kim et al. (2021) reported that limited English proficiency was associated with having undiagnosed diabetes.

Rural residents are less likely than urban residents to receive regular medical check-ups (Casey et al., 2000; Krishna et al., 2010). Individuals residing in rural communities may find it difficult to visit their doctor due to lack of transportation or economic hardships (Thomas et al., 2018). Also, health literacy is positively associated with medication engagement among individuals with diabetes (Chima et al., 2020).

Previous studies on the social determinants access to medical care have emphasized the descriptive analyses only. Previous studies that utilized inferential analyses, did so using on sequential analysis that focused on one predictor variable at a time. However, the present study extends beyond sequential analyses to jointly determine the effect of predictor variables on the response variable. In the current study, we utilized both parametric and nonparametric inferential methods. Furthermore, up-sampling (Chawla et al. (2002), a data processing and optimization technique (a machine learning tool) was used to create a balanced data set to enhance analyses. The application of the up-sampling technique was to address the weakness that are generally associated with demographic survey data sets.

Purpose of the Study

Accessing diabetic care promptly is crucial for the prevention of complications and death due to undiagnosed cases. Therefore, the present study examined the predictive power of health-related social factors on access to medical care among 2,620 individuals with diabetes in the United States. Understanding the predictive power of health-related social needs on access to medical care for individuals with diabetes is crucial for developing targeted interventions and policies.

Research Questions

The following research questions underpinned the study:
1. To what extent do individuals with diabetes delay seeking medical care due to cost?
2. How do demographic factors predict individuals with diabetes delaying seeking medical care due to cost?
3. How does geographic location predict individuals with diabetes delaying seeking medical care due to cost?
4. How does socioeconomic status predict individuals with diabetes delaying seeking

medical care due to cost?

Method
Participants

The studied participants included 2,620 individuals aged 18-85 years (Median = 66; Interquartile Range = 57, 74) diagnosed with diabetes in the United States. We arrived at this sample size after a series of data cleaning and preprocessing. First, we removed any duplicate records to avoid redundancy. Second, we addressed missing values by excluding incomplete observations. Finally, outliers were identified and reviewed to determine if they were data entry errors or otherwise. These processes resulted in a final sample size of 2,620 individuals diagnosed with diabetes.

Data and Variables

The data for this study were sourced from microdata records provided by the Demographic Health Survey, which is part of the Integrated Public Use Microdata Series (IPUMS) (Blewett et al., 2023). The IPUMS is a comprehensive database that includes various demographic and health-related information collected through national surveys.

The primary outcome of interest (response variable) was whether participants delayed seeking medical care due to worry about cost. This variable was binary, with responses categorized as either "Yes" (indicating a delay in seeking medical care) or "No" (indicating no delay). The following were the predictor variables for the study: diabetes type, sex, age, region, and employment status. Diabetes type was categorized as Type 1 and Type 2 diabetes, sex was classified into male and female, while age was measured in years. The region of residence was defined by geographical areas within the United State and employment status was categorized as employed or unemployed.

Statistical Analysis

Descriptive statistics, including frequencies, percentages, and quartiles, were calculated to provide an overview of the demographic and health characteristics of the studied participants. These descriptive statistics helped to outline the general characteristics of the study population, revealing both distribution and variability in key demographic and health metrics.

Several inferential statistical tests were conducted to investigate the associations between the predictor and response variables. Pearson's Chi-Squared Test was used to evaluate the associations between categorical variables, such as sex and types of diabetes, with the response variable. The Wilcoxon Rank Sum Test was applied to compare the age

distribution between those who delayed seeking medical care and those who did not, providing a non-parametric alternative to the t-test for comparing two independent samples. Finally, the Binary Logistic Regression with Up-sampling was performed to model the probability of delaying medical care based on the predictor variables. Given the potential imbalance in the response variable (that is, fewer individuals who delayed care as compared to those who did not), up-sampling was employed to balance the class distribution. Up-sampling (Chawla et al. (2002) involves replicating the minority class to achieve a more balanced dataset, thereby improving the model's predictive performance. Up-sampling is usually accomplished by imitating existing class observations. For example, if the minority class has rarer observations, some of these observations are duplicated until the number of minority class is comparable to that of the majority class. All significance tests were conducted at a 0.05 level of significance. This was done to ensure that results were statistically robust and minimized the likelihood of Type I errors.

Results
Individuals with Diabetes Delaying Seeking Medical Care due to Cost

Table 1 shows summary statistics for individuals with diabetes who delayed seeking medical care due to cost. The data show that approximately 6% delayed seeking medical care. Sex and employment status were found to be associated with delaying seeking medical care. In addition, there was a significant difference in Age in delaying seeking medical care. Furthermore, Diabetes Type and Region were not associated with delaying seeking medical care.

Table 1: Summary statistics

Variable	N	**1**, N = 2,459[1]	**2**, N = 161[1]	**p-value**[2]
DIABETES TYPE	2,620			0.8
Type 1		216 (8.8%)	13 (8.1%)	
Type 2		2,243 (91%)	148 (92%)	
SEX	2,620			0.020
Male		1,194 (49%)	63 (39%)	
Female		1,265 (51%)	98 (61%)	
AGE	2,620	66 (58, 75)	57 (49, 64)	<0.001
REGION	2,620			0.5
Northeast		372 (15%)	24 (15%)	
North Central/Midwest		559 (23%)	29 (18%)	
South		1,033 (42%)	75 (47%)	
West		495 (20%)	33 (20%)	
EMPLOYMENT STATUS	2,620			<0.001
Not Employed		1,617 (66%)	77 (48%)	
Employed		842 (34%)	84 (52%)	

[1] n (%); Median (IQR)

[2] Pearson's Chi-squared test; Wilcoxon rank sum test

Health-related social factors on Individuals with Diabetes Delaying Seeking Medical Care due to Cost

Table 2 displays binary logistic regression analysis with an up-sampling of individuals with diabetes who delayed seeking medical care due to cost. The data show

that the odds for females delaying seeking medical care were about 51% higher than for males. Also, as Age increases by a year, it was expected that the odds of delaying seeking medical care due to cost decreased by about 4%. Finally, Diabetes Type, Region, and Employment Status were not significant predictors of delaying seeking medical care due to cost.

Table 2: Binary logistic regression analysis with up-sampling

Characteristic	OR[1]	95% CI[1]	p-value
(Intercept)	0.443	0.151, 1.236	0.128
DIABETES TYPE			
Type 1	—	—	
Type 2	1.739	0.977, 3.355	0.077
SEX			
Male	—	—	
Female	1.512	1.087, 2.119	0.015
AGE	0.956	0.944, 0.969	0.000
REGION			
Northeast	—	—	
North Central/Midwest	0.762	0.433, 1.352	0.348
South	1.084	0.677, 1.791	0.745
West	0.983	0.568, 1.725	0.952
EMPLOYMENT STATUS			
Unemployed	—	—	
Employed	1.227	0.849, 1.774	0.276

[1] OR = Odds Ratio, CI = Confidence Interval

Discussion and Conclusions

The current study examined the predictive power of health-related social factors on access to medical care among 2,620 individuals with diabetes in the United States. Approximately 6% of the respondents indicated they delayed in seeking medical care due to worry about cost. The financial means for health insurance coverage is a key factor in accessing medical care.

Females had higher odds of delaying seeking medical care due to cost than their male counterparts. One plausible reason for this finding may be that females use healthcare services more than males, resulting in the depletion of their financial resources more than men. This is exacerbated by the gender inequality in pay, where women earn less and are more likely to be poor (Chelak & Chakole, 2023). Second, societal expectations place the burden of the caregiving role on women, making them not prioritize their health concerns. Age was a significant predictor of delaying seeking medical care due to worry about cost. Older adults would more likely have attained financial stability than the younger population. This can protect them from healthcare costs than the younger generations who might lack well-established careers and thus lower savings. Also, the Medicare program provides lower healthcare costs to adults 65 years old and above. Alternatively, younger individuals must deal with higher costs from private health insurance plans. This is consistent with previous research which reported that younger individuals were more likely to delay seeking medical care than the elderly (Brewster et al., 2020). In another study, Ratnapradipa et al. (2023) found that the odds of delaying care were greater for those less than 45 years old than for those 45-64 years or those 65 years or older

Region as a variable was not a significant predictor of individuals with diabetes delaying seeking medical care due to cost. Free or low-cost healthcare services available in communities may have minimized regional differences in the access of healthcare. This finding is inconsistent with that of Gurka et al. (2018) who reported significant differences in diabetes prevalence among regions of the U.S. In another study, Ledford et al. (2019) found regional differences in diabetes prevalence.

Diabetes type was not an important predictor of patients' delaying in seeming healthcare services due to cost. Healthcare services for Type 1 and Type 2 diabetes may be similar, thus resulting in similar cost-related delays for patients' suffering from the two types of diabetes. This finding is inconsistent with that of Joish et al. (2020) which indicated that the total annual cost of Type 1 diabetes was significantly higher than that of Type 2 diabetes.

Diabetes patients delaying seeking medical care due to cost had no relationship with employment status. This finding conflicts with that of Walker (2023) which reported a significant positive association between income and access to medical care. Respondents

with higher incomes were less likely than those with lower incomes to report they could not see a doctor due to cost (Walker, 2023).

The association of lower socioeconomic status with higher diabetes prevalence warrants policies to support economic opportunities and quality education for all (Hill-Briggs & Fitzpatrick, 2023). Walker et al. (2015) suggested a shift from the traditional focus on education and skills training in diabetes to strategies that integrate interventions that target critical social determinants of health such as social support. Furthermore, improved access to healthcare services leads to better diabetes management and reduced complications (Norris et al., 2002).

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