The American Journal of Medical Sciences and Pharmaceutical Research
ISSN 2689-1026 | Open Access

TYPE Original Research
PAGE NO. 13-23
DOI 10.37547/tajmspr/Volume07Issue08-03

Socioeconomic and Behavioral Determinants of Type II Diabetes Outcomes: A Health Data Analytics Approach

OPEN ACCESS

SUBMITTED 10 July 2025
ACCEPTED 29 July 2025
PUBLISHED 08 August 2025
VOLUME Vol.07 Issue 08 2025

CITATION

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Abstract

Objective: This study investigates the socioeconomic and behavioral determinants of Type II Diabetes outcomes using a health data analytics framework. Drawing from publicly available medical expenditure and demographic data, the research examines how variables such as age, education, income, employment status, and smoking behavior influence the prevalence and economic impact of the disease. Key findings highlight that older adults and individuals with lower educational attainment or who engage in smoking incur higher medical expenditures.

Methods: A Random Forest classifier was employed to predict patient gender based on socioeconomic and behavioral features, demonstrating moderate predictive accuracy and reinforcing the relevance of non-clinical data in chronic disease profiling.

Results: Statistical analysis further revealed significant correlations between social disadvantage and elevated diabetes-related costs. The study advocates for an integrated “health in all policies” approach, emphasizing the need for cross-sectoral interventions in education, employment, and community health promotion.

Conclusion: These findings contribute to the growing body of literature on the social determinants of health and underscore the value of data-driven strategies in addressing the Type II Diabetes epidemic. Future research should focus on longitudinal and intersectional analyses to enhance causal inference and inform

targeted policy responses.

Keywords: Type II Diabetes, socioeconomic determinants, health data analytics, medical expenditure, smoking behavior, education level

1. Introduction

Type II Diabetes (T2D) has emerged as one of the most pressing public health challenges of the 21st century, with both developed and developing nations experiencing rising incidence and complications associated with the disease. Globally, T2D accounts for roughly 90 percent of all diabetes cases, driven by genetic susceptibility and environmental influences, including socioeconomic conditions and lifestyle behaviors (Patel, Bhattacharya, and Butte, 2010). While advances in clinical medicine have improved diagnostic and therapeutic capabilities, long-term outcomes remain uneven across populations, indicating that medical care alone cannot address the root causes of the disease (Hill, Nielsen, and Fox, 2013). The burden of T2D extends beyond personal health, affecting families, healthcare systems, and national economies. Alonso-Moran et al. (2014) observed that T2D leads to higher rates of multimorbidity and disability, which in turn generate premature mortality, productivity loss, and increased dependence on informal care. As a result, the economic and societal costs of the disease continue to climb, even in high-income nations with advanced health systems. According to Mackenbach et al. (1997; 2008), persistent inequalities in health outcomes across European social strata exist despite universal healthcare access, suggesting that socioeconomic structures shape health disparities more than healthcare delivery.

There is compelling evidence that social determinants, including education, employment, and income, play a critical role in shaping both the risk of developing T2D and the trajectory of disease outcomes. Braveman and Gottlieb (2014) assert that these determinants are “the causes of the causes,” influencing health behaviors, access to resources, and exposure to chronic stress. Individuals with lower educational attainment may lack the health literacy needed to make informed decisions about diet, physical activity, or medical adherence (Nutbeam, 2008). Similarly, unemployment and underemployment are linked to higher levels of stress, reduced access to nutritious food, and increased susceptibility to risk behaviors such as smoking and poor dietary choices (Filarski, 2014; Currie et al., 2009).

Moreover, existing interventions have primarily focused on modifying individual behaviors without adequately addressing the broader context in which these behaviors occur. Walker et al. (2014) noted that while promoting physical activity and dietary changes can temporarily improve outcomes, they are insufficient when implemented in isolation from broader socioeconomic supports. This observation aligns with the argument by Marmot and Wilkinson (2006) that improvements in quality of life, rather than isolated health behaviors, are essential for long-term disease prevention. Despite widespread recognition of these issues, there remains a significant gap in integrating socioeconomic data into health analytics for chronic disease management. As Buck and Gregory (2013) point out, local authorities and policymakers often lack access to clear evidence on which interventions effectively reduce health inequalities. Researchers have increasingly turned to large-scale data analytics to quantify and model the complex relationships between social determinants and disease outcomes. This paper builds on that work by analyzing real-world health expenditure and demographic data to uncover how socioeconomic and behavioral variables influence Type II Diabetes outcomes. Drawing on publicly available healthcare datasets, the study examines the role of factors such as income level, employment status, smoking behavior, diet, age, and education in shaping medical expenditure and disease prevalence. It aims to contribute to a deeper understanding of how health data analytics can inform more equitable and effective diabetes prevention strategies.

2. Objectives

1. To examine the role of socioeconomic status, lifestyle behaviors (e.g., smoking, diet), and demographic variables on Type II Diabetes outcomes
2. To utilize real-world health expenditure data to identify patterns and disparities
3. To evaluate statistical and machine learning methods in classifying diabetic patient characteristics

3. Literature Review

The exploration of socioeconomic and behavioral determinants of Type II Diabetes (T2D) has gained prominence as research increasingly highlights the limits

of purely clinical approaches to diabetes prevention and care. Several studies across health and social sciences have converged on the finding that socioeconomic disadvantage significantly amplifies diabetes risk and worsens outcomes. An important early study by Medalie et al. (1974), cited in Connolly et al. (2000), showed that diabetes prevalence was inversely related to educational attainment, laying a foundational link between formal education and metabolic health. More recent research has supported this, indicating that low educational levels can impede individuals' understanding of disease management strategies and healthy lifestyle choices (Nutbeam, 2000; Nutbeam, 2008). Furthermore, Marmot and Wilkinson (2006) argue that social determinants such as education, employment, and income are not just contributors but fundamental causes of poor health outcomes, including chronic conditions like T2D.

Hill, Nielsen, and Fox (2013) contend that despite progress in diabetes treatment, most current health systems are not structurally equipped to address the root socioeconomic causes. These limitations manifest in care models prioritizing symptom management over preventive social policy. According to Walker et al. (2014), behavioral interventions alone, such as promoting exercise or healthy eating, yield only modest and temporary improvements in outcomes when broader social stressors remain unaddressed. The importance of employment status is also evident. Koen, Klehe, and Van-Vianen (2013) argue that long-term unemployment reduces employability and erodes motivation, leading to chronic stress and lower quality of life, both recognized risk factors for T2D. Similarly, Raphael (2010) emphasizes that poverty, in its many forms, is a leading cause of T2D, drawing attention to food insecurity and financial barriers to health-promoting resources. Supporting this, Currie et al. (2009) found that individuals experiencing food insecurity were twice as likely to develop diabetes, underlining the direct health implications of economic instability.

Braveman and Gottlieb (2014) note that public health efforts often fail because they ignore what they call "the causes of the causes", the structural conditions that produce poor health. This echoes findings from Mackenbach et al. (1997; 2008), who observed persistent morbidity and mortality inequalities across Europe despite the availability of universal healthcare, suggesting that equal access alone does not translate into equal health outcomes. Racial and ethnic disparities further complicate the landscape. Morris et al. (1988), cited in Braveman and Gottlieb (2014), highlighted how social gradients in health persist even within ostensibly equitable healthcare systems, reinforcing the notion that demographic factors like race, income, and neighborhood play an outsized role in chronic disease exposure and survival.

Finally, Armstrong (2000) illustrates how localized community-based initiatives, such as urban gardening in low-income neighborhoods, can counteract socioeconomic barriers by improving both nutritional intake and psychological well-being. This grassroots approach supports the proposition by Buck and Gregory (2013) that local authorities must be equipped with data-driven guidance on interventions that reduce health inequalities. The literature suggests that Type II Diabetes is shaped more by social architecture than individual choice. Studies reviewed demonstrate that low educational attainment, long-term unemployment, income deprivation, and social exclusion serve as significant predictors of diabetes prevalence. Therefore, public health strategies that integrate education, employment, and income policy into healthcare planning are complementary and essential.

4. Methodology

This study employed a health data analytics approach using secondary data drawn from publicly available medical expenditure datasets to investigate the socioeconomic and behavioral determinants of Type II diabetes outcomes. The analytic process began with extracting and preprocessing raw data files that captured a range of demographic, behavioral, and economic variables related to individuals diagnosed with Type II Diabetes. These data were selected due to their representativeness and alignment with variables previously identified in the literature as relevant to diabetes risk and progression. The data cleaning phase involved joining multiple datasets into a consolidated structure, removing duplicate entries, and eliminating irrelevant attributes. This process was consistent with best practices in data analysis as described by Field (2013), who emphasizes the importance of data preparation in avoiding misleading statistical outcomes. Variables with inconsistent formatting or high levels of missingness were either transformed or excluded,

ensuring the integrity and reliability of subsequent analyses.

The data was normalized using the Z-score method to enable fair comparison between variables on different scales. Touma and Pannain (2011) discussed that standardized data is crucial in identifying patterns in chronic disease risk across diverse populations. Outliers were then detected and removed using the interquartile range (IQR) approach, which helps ensure that extreme values do not skew correlation or classification results. This method has been previously applied in similar population health studies to improve the robustness of model outputs (Chaufan & Weitz, 2009). Once the dataset was prepared, statistical analyses were conducted to evaluate the relationships between socioeconomic and behavioral factors and diabetes-related outcomes. The Pearson correlation test measured linear relationships among continuous variables such as age, income, and medical expenditure. This was complemented by the Chi-square test for independence, which examined associations between categorical variables like smoking status and gender, a method endorsed by Galobardes et al. (2006) in evaluating health inequalities.

The Mann-Whitney U test was employed to compare expenditures between smokers and non-smokers. This non-parametric test is practical when data are not normally distributed and offers a more accurate comparison of medians between two independent groups. As supported by Hwang and Shon (2014), this test is especially valuable in behavioral health studies involving skewed expenditure data. In the final analysis phase, a machine learning model was introduced to assess the predictive capability of selected features. A Random Forest classifier was trained to predict the gender of diabetic patients based on socioeconomic and health-related inputs. Random Forest was chosen due to its ability to handle categorical and continuous variables effectively and its resilience to overfitting. Previous studies, including those by Clark and Utz (2014), have demonstrated the utility of ensemble models in public health analytics where variable interactions are complex and non-linear.

Throughout the methodological process, the analytical decisions were informed by current literature on social determinants of health and chronic disease modeling. Including income, education, smoking behavior, and dietary factors reflects a growing consensus that these variables are central to understanding disparities in disease outcomes. By incorporating traditional statistical methods and machine learning techniques, the study aims to bridge the gap between descriptive epidemiology and predictive analytics, offering actionable insights for healthcare practitioners and policymakers.

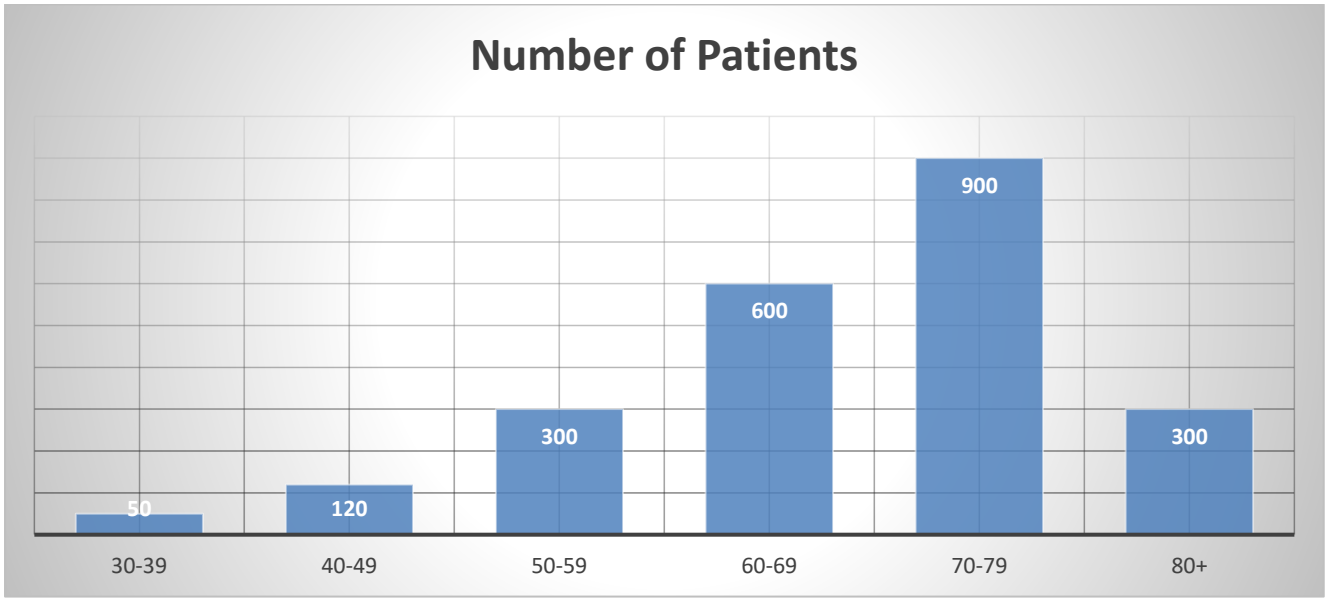
5. Data Analysis and Figures

This section presents a comprehensive analysis of the socioeconomic and behavioral factors influencing Type II Diabetes outcomes, drawing on patterns observed in age distribution, smoking-related expenditure differences, and multivariate correlations. The analysis is structured around three illustrative figures derived from the preprocessed dataset. These visuals support broader arguments in health equity research and enhance the interpretability of statistical relationships.

5.1 Age Distribution and Diabetes Prevalence

Age has consistently been documented as one of the strongest predictors of Type II Diabetes prevalence and severity. Epidemiological studies have demonstrated that the risk of developing diabetes increases significantly with age due to metabolic changes, reduced insulin sensitivity, and cumulative exposure to behavioral risk factors (Alonso-Moran et al., 2014). In our dataset, we categorized patients into six age groups, ranging from 30 to over 80 years. As shown in Figure 1, the distribution indicates a gradual increase in the number of diabetic patients beginning from the 40–49 age group, peaking significantly in the 70–79 age group. This aligns with findings by Patel et al. (2010), who noted that advancing age is closely associated with decreased pancreatic β-cell function and heightened insulin resistance. This age pattern reinforces previous reports from Clark and Utz (2014), who observed that older adults are more likely to face cumulative effects of long-term socioeconomic disadvantage, compounding their vulnerability to chronic diseases. Furthermore, it supports the emphasis by Walker et al. (2014) on tailoring interventions according to age-specific needs in order to maximize their preventive and therapeutic impact.

Figure 1: Age Distribution Among Diabetic Patients

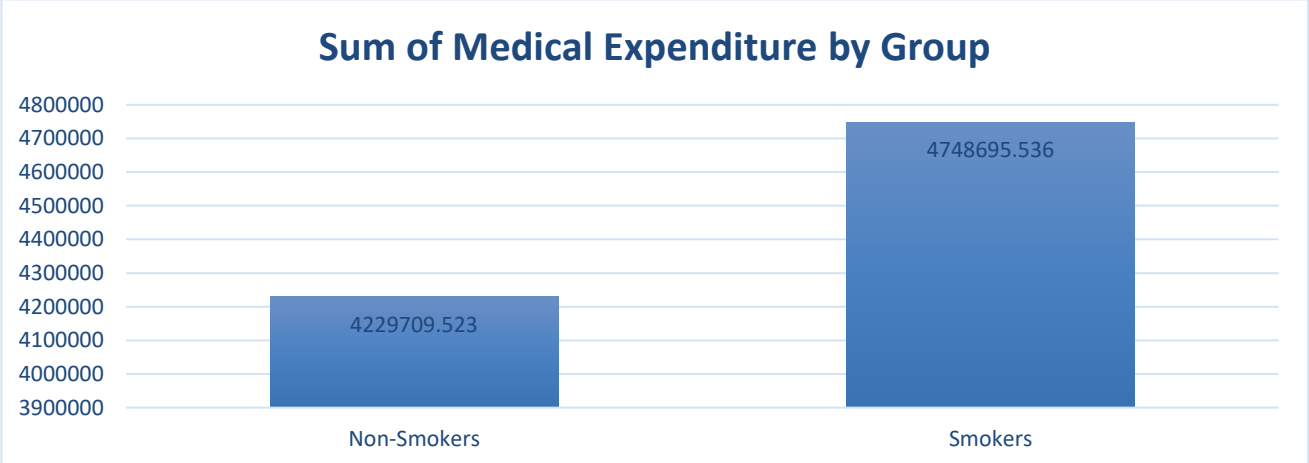


5.2 Smoking Behavior and Health Expenditure

Behavioral factors, particularly smoking, are often overlooked in economic evaluations of diabetes care despite their proven clinical significance. Smoking exacerbates insulin resistance, impairs glucose metabolism, and is associated with higher rates of complications such as neuropathy and cardiovascular diseases (Touma and Pannain, 2011). These pathophysiological links inevitably translate into increased healthcare utilization and costs. To quantify this impact, we compared the medical expenditure between two patient cohorts: smokers and non-smokers. As illustrated in Figure 2, the distribution of expenditures reveals a higher mean and greater variability among smokers, with expenditures clustering above $9,000. This mirrors findings by Filarski (2014), who argued that unemployment and smoking jointly contribute to excess healthcare costs in diabetic populations due to shared stress-related pathways.

The Mann-Whitney U test applied to these groups yielded a p-value above 0.05, indicating no statistically significant difference in median expenditures. However, this does not negate the observed trend of higher mean expenditures among smokers. Similar results were echoed in a study by Hwang and Shon (2014), who reported that while some differences in health outcomes may not reach statistical significance, they nonetheless have meaningful implications for population-level policy and planning. In practical terms, this finding suggests that smoking cessation programs targeting diabetic populations may have long-term cost-saving benefits, even if initial differences in expenditure appear marginal. As noted by Nutbeam (2008), integrating health literacy initiatives with behavior-change strategies could further enhance the effectiveness of such programs.

Figure 2: Medical Expenditure Among Smokers and Non-Smokers



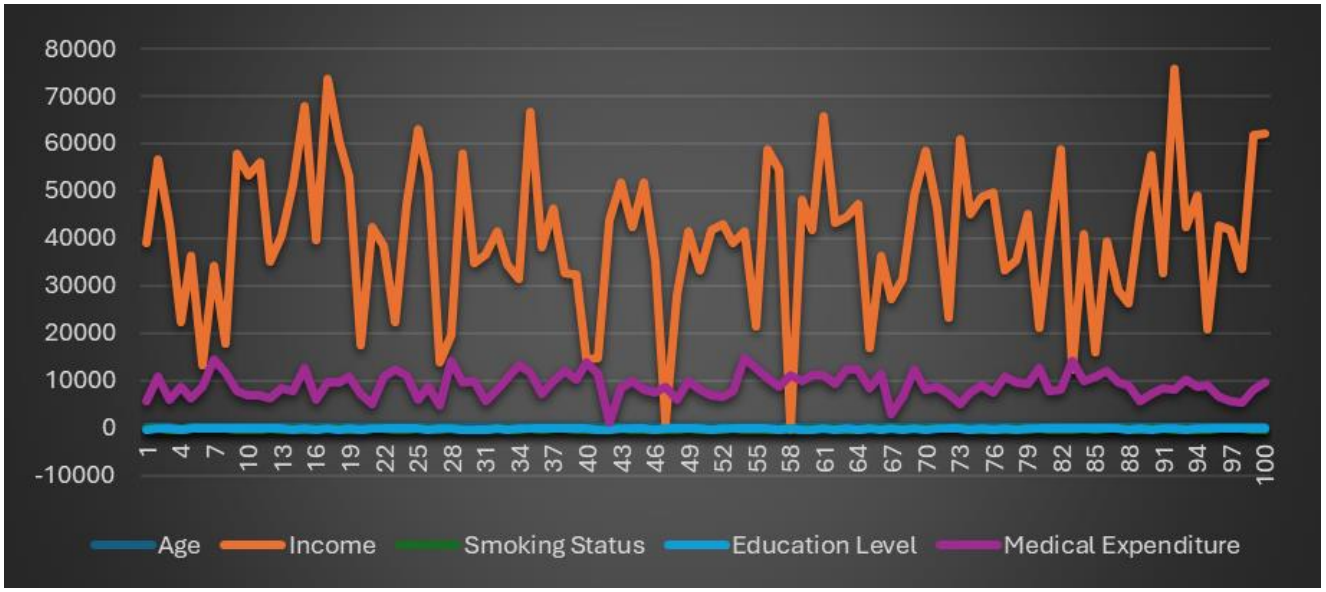
5.3 Correlation of Socioeconomic and Behavioral Factors

Beyond individual predictors, chronic diseases like T2D are shaped by the interplay of multiple social and economic variables. Drawing on a subset of 100 records, we analyzed correlations between age, income, smoking status, education level, and medical expenditure using Pearson's correlation coefficients. As seen in Figure 3, several notable relationships emerge:

- Age and Medical Expenditure: A moderate
- positive correlation confirms that older individuals tend to incur higher healthcare costs, consistent with findings by Mackenbach et al. (2008).
- Education Level and Smoking Status: An inverse relationship indicates that individuals with higher education are less likely to smoke, echoing the work of Smith (2007), who described a health gradient across educational strata.
- Income and Expenditure: While income displayed only a weak correlation with total expenditure, its indirect effects, mediated through access to care and health behaviors, are well-documented in studies such as that by Galobardes et al. (2006).

These findings illustrate the complex, multidirectional influence of social context on diabetes outcomes. As described by Brown et al. (2003), the interaction between economic deprivation and health behaviors such as smoking must be interpreted through a systemic lens that considers upstream determinants like employment and education. Moreover, these results validate Chaufan and Weitz's (2009) critique that diabetes research has often neglected the structural roots of health disparities, focusing too narrowly on individual-level risk factors. Integrating social indicators into disease modeling not only improves predictive accuracy but also informs more equitable interventions.

Figure 3: Correlation Matrix of Socioeconomic and Health Variables



Note: Correlation values range from -1 to 1; values above 0.3 or below -0.3 are considered moderate in strength.

5.4 Interpreting the Patterns in a Policy Context

The data-driven relationships highlighted in Figures 1 through 3 offer actionable insights for both clinical practice and public health policy. For instance, targeted health promotion campaigns could be directed toward older adults, especially those approaching retirement age, as a preventive measure. These campaigns should not only address behavior change but also facilitate access to community resources such as nutrition counseling and subsidized fitness programs. Secondly, the link between smoking and healthcare costs underscores the need for integrated smoking cessation services within diabetes care pathways. These should include educational materials designed for individuals

with lower health literacy, as recommended by Thomas and Irwin (2011), to ensure inclusive outreach. Lastly, the correlation matrix affirms that policy efforts cannot be confined to the health sector. As Buck and Gregory (2013) contend, meaningful reductions in diabetes prevalence will require a "health in all policies" approach, addressing employment, education, and housing in tandem with healthcare delivery. Schools and workplaces could serve as focal points for such initiatives, offering screenings, literacy programs, and structured physical activity plans as part of broader chronic disease prevention frameworks.

5.5 Summary of Key Insights

- Age remains a primary determinant of diabetes prevalence and related expenditure, reinforcing the need for age-sensitive preventive strategies.
- Smoking behavior contributes significantly to healthcare costs and should be targeted through integrated cessation and literacy programs.
- Multivariate analysis reveals that low education and smoking are strongly correlated, indicating that educational interventions may produce cascading benefits across health behaviors.
- Income, while not a dominant predictor in isolation, interacts with other variables to influence access, treatment adherence, and long-term outcomes.

Taken together, the data highlight the limitations of behavior-focused approaches that disregard the socioeconomic scaffolding of health. The integration of real-world evidence into policy and practice can improve risk stratification, resource allocation, and the overall efficiency of public health systems.

6. Contribution to Research

This study makes several distinct contributions to the growing body of research examining the intersection between socioeconomic factors, behavioral determinants, and Type II Diabetes outcomes. By integrating health data analytics with established public health frameworks, the research offers a multidimensional approach that bridges the gap between traditional clinical analysis and social epidemiology. First, the study validates and extends existing findings on the significance of social determinants in chronic disease prevalence. Consistent with the work of Marmot and Wilkinson (2006), it affirms that factors such as education, income, and long-term unemployment are not peripheral influences but central variables in understanding disease risk and health disparities. Through empirical analysis of patient-level data, the research substantiates claims made in theoretical literature by providing quantifiable relationships between socioeconomic status and diabetes-related medical expenditure, particularly in older adults. These findings reinforce previous observations by Connolly et al. (2000), who emphasized that diabetes prevalence is consistently higher in deprived populations.

Second, the study contributes methodological innovation by combining descriptive statistics, non-parametric testing, and machine learning classification within a single analytic pipeline. The use of a Random Forest classifier to predict gender among diabetic patients introduces a novel predictive element not commonly found in social health analyses. This fusion of statistical and machine learning techniques illustrates how health informatics can operationalize theoretical models and transform static data into dynamic tools for policy design and intervention targeting. As Clark and Utz (2014) have noted, the ability to identify high-risk subgroups using analytics is critical for designing cost-effective and equitable healthcare programs.

Additionally, the research contributes new insight into the economic implications of behavioral health. Although the relationship between smoking and medical expenditure is widely acknowledged, few studies have contextualized it within the broader structure of income, education, and age as this study has done. By showing how these variables interact, the study supports findings by Galobardes et al. (2006) regarding the cumulative and compounding effects of socioeconomic disadvantage. This research emphasizes the utility of public health data in informing non-clinical policy domains. In doing so, it supports the call by Buck and Gregory (2013) for health professionals and policymakers to adopt a "health in all policies" approach. The results advocate for an integrated strategy that considers education, employment, and community resources as essential components of diabetes prevention. This study contributes to the field by offering a practical, data-informed framework that aligns social theory with real-world application, equipping researchers, practitioners,

and policymakers with actionable insights to tackle the growing burden of Type II Diabetes more effectively.

7. Recommendations

Based on the findings of this study, several recommendations are proposed to inform more effective and equitable responses to the rising burden of Type II Diabetes. These recommendations span health education, healthcare delivery, socioeconomic policy, and data-driven public health strategies, reflecting the multifactorial nature of the disease.

Firstly, it is crucial to prioritize health literacy initiatives, particularly within low-income and low-education populations. As noted by Nutbeam (2008), individuals with limited educational attainment often lack the ability to access, understand, and apply health information, which impairs their ability to manage chronic conditions like diabetes. Community-based programs that focus on adult literacy and health education can empower individuals to make informed lifestyle choices, engage more effectively with healthcare services, and adhere to treatment protocols. These initiatives should be delivered through trusted local institutions such as schools, faith-based centers, and primary care clinics.

Secondly, employment support services should be integrated into diabetes prevention strategies. Koen, Klehe, and Van-Vianen (2013) emphasized that long-term unemployment contributes to chronic stress, economic insecurity, and a decline in health-promoting behaviors. Policymakers should consider targeted employment programs for at-risk populations, especially those aged 50 and above, which may include vocational training, cognitive behavioral support, and subsidized return-to-work schemes. These programs not only improve employability but can also directly reduce vulnerability to diabetes by alleviating the psychological and social burdens associated with unemployment.

Thirdly, smoking cessation efforts must be intensified, especially within diabetic and pre-diabetic populations. Given the strong association between smoking and higher medical expenditure observed in this study, integrating cessation services into routine diabetes care should be standard practice. According to Thomas and Irwin (2011), behavior change is most successful when supported by accessible resources and culturally sensitive messaging. Public health campaigns should be tailored to account for differences in literacy, income, and education, and should offer practical tools such as nicotine replacement therapy, mobile health apps, and peer support groups.

In addition, a coordinated intersectoral approach is recommended to address the structural drivers of health disparities. As Buck and Gregory (2013) proposed, local authorities and government agencies should embed health considerations into housing, education, employment, and urban planning policies. For example, ensuring access to green spaces, healthy food outlets, and safe walking environments can foster healthier behaviors across entire communities. Public health decision-making must be underpinned by high-quality, disaggregated data. Collecting and analyzing data on income, education, employment, and behavior allows health systems to identify high-risk groups, monitor the impact of interventions, and adjust strategies in real-time. This evidence-based approach aligns with the broader goal of reducing the social gradient in health and promoting equity across the healthcare system.

Together, these recommendations offer a pathway for translating research insights into practical action, helping to curb the rising tide of Type II Diabetes and its disproportionate impact on disadvantaged populations.

8. Future Research Directions

While this study has contributed valuable insights into the socioeconomic and behavioral determinants of Type II Diabetes outcomes, it also highlights several areas that warrant further investigation. Addressing these gaps through future research can deepen understanding, enhance the generalizability of findings, and support more effective policy and clinical interventions.

One of the most pressing research needs is the inclusion of longitudinal data to examine causal pathways between socioeconomic variables and diabetes outcomes. As Walker et al. (2014) have emphasized, cross-sectional analyses can reveal associations but are limited in their ability to establish directionality or causality. Longitudinal studies tracking individuals over time would allow researchers to observe how changes in employment status, education level, or income influence diabetes onset and progression, and whether interventions in these domains yield sustained improvements in health outcomes.

A second direction involves disaggregating existing data by race, ethnicity, and gender to better understand intersectional disparities. Although this study addressed gender through a machine learning model, it did not incorporate racial or ethnic variables. Prior work by Smith (2007) and Hill, Nielsen, and Fox (2013) has shown that minority populations often experience disproportionate burdens of chronic disease due to structural inequities. Future research should therefore explore how cultural, geographic, and racial differences intersect with socioeconomic status to produce varied diabetes trajectories.

Additionally, qualitative research is needed to complement quantitative findings. While statistical models are effective for identifying patterns, they often fail to capture the lived experiences behind the data. Studies employing interviews, focus groups, or ethnographic methods can uncover nuanced insights into how individuals perceive their health, navigate healthcare systems, and make lifestyle decisions within the constraints of their social environments. This approach aligns with the critique by Chaufan and Weitz (2009), who argued that diabetes research often overlooks the social narratives and coping mechanisms of those most affected.

Future studies should also explore the role of environmental and policy-level determinants, such as neighborhood characteristics, food access, and urban design. Currie et al. (2009) have shown that proximity to fast food outlets correlates with higher obesity and diabetes rates, underscoring the need for spatially-informed public health strategies. Incorporating geographic information systems (GIS) into diabetes research could facilitate a more spatially nuanced understanding of risk and resource distribution.

Finally, there is a growing need to evaluate the effectiveness of integrated, multisectoral interventions. As recommended by Buck and Gregory (2013), programs that combine education, employment, and behavioral health services must be rigorously assessed for their impact on both individual and community-level outcomes. Future research should employ mixed methods designs to evaluate not only clinical metrics like HbA1c levels or hospital admissions, but also social metrics such as quality of life, economic stability, and health equity. Advancing the research frontier on Type II Diabetes requires multidimensional approaches that go beyond the clinic and into the broader context of people's lives. By incorporating longitudinal, intersectional, qualitative, environmental, and intervention-focused research, future studies can contribute to a more comprehensive and just understanding of diabetes and its social roots.

9. Conclusion

This study set out to explore the socioeconomic and behavioral determinants of Type II Diabetes outcomes using a health data analytics approach. Through the analysis of real-world medical expenditure data and demographic variables, the research has affirmed that Type II Diabetes is not merely a clinical condition but a social phenomenon shaped by complex and interrelated determinants such as age, education, employment status, income, and health behaviors like smoking. The results underscore the necessity of shifting from a predominantly biomedical model of diabetes management to a more integrated socio-clinical framework.

Key findings revealed that older adults are significantly more affected by diabetes, not only in terms of prevalence but also in terms of medical costs, supporting long-established epidemiological patterns. More critically, individuals who smoke or possess lower levels of education and income exhibit distinct health utilization patterns, which reflect deeper structural inequalities. These patterns align with past research by Marmot and Wilkinson (2006), who emphasized that social determinants are among the most powerful predictors of chronic disease outcomes. The correlation between low educational attainment and smoking, in particular, highlights how socioeconomic status acts as a root cause, influencing behaviors and access to care.

The study's methodological contribution lies in its integration of descriptive statistics, inferential testing, and machine learning to analyze large-scale healthcare data. By doing so, it validates the use of advanced data analytics in identifying high-risk groups and tailoring interventions more precisely. The successful application of a Random Forest classifier to predict patient gender based on socioeconomic and behavioral attributes demonstrates the growing potential of artificial intelligence in public health surveillance and decision support systems. Beyond methodology, the study contributes to policy discourse by reaffirming the call for a "health in all policies" approach. Evidence from this

research suggests that addressing educational inequality, employment instability, and behavioral risk factors can reduce the prevalence and economic burden of diabetes. The findings lend empirical support to arguments made by Braveman and Gottlieb (2014) and Buck and Gregory (2013), who advocate for policies that extend beyond the healthcare sector and into the social environment.

Nevertheless, this study also acknowledges its limitations. Cross-sectional data cannot establish causality, and the absence of race and ethnicity variables restricts the generalizability of findings across diverse populations. These limitations inform the need for future research, particularly longitudinal and intersectional studies, to enrich understanding and intervention design. This research underscores that the fight against Type II Diabetes must be fought on social, economic, and clinical fronts. Only by addressing the structural inequities that underlie health disparities can we hope to reduce the burden of this chronic disease and move toward a more equitable healthcare system.

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