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Analysis of the Correlation between Health Risk Behavior and
Educational Attainment of Adults in the United States
(1970-2018)

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Beril Müge Günay

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Mag. Dr. Wolfgang Lutz

Kurzfassung

Diese Studie wurde durchgeführt, um die Veränderung des Zusammenhangs zwischen gesundheitsgefährdendem Verhalten und Bildungsabschluss über 48 Jahre zwischen 1970 und 2018 in den Vereinigten Staaten zu untersuchen. Alkoholkonsum und Rauchen wurden in der Studie explizit als gesundheitsgefährdende Verhaltensweisen ausgewählt. Diese Studie untersuchte Alkoholkonsum und Rauchverhalten, beides gesundheitsgefährdende Verhaltensweisen von Erwachsenen im Alter von 25 bis 60 Jahren in den Vereinigten Staaten. Die in der Studie verwendeten Daten wurden durch die National Health Interview Survey (NHIS) bereitgestellt. Die Studie ergab, dass ein Zusammenhang zwischen Bildungsabschluss und gesundheitsgefährdendem Verhalten besteht. Mit steigendem Bildungsabschluss nahm das Rauchen ab, während der Alkoholkonsum zunahm. Diese Studie zeigte, wie sich der Bildungsabschluss auf das gesundheitsgefährdende Verhalten von Personen auswirkt und wie sich dieser im Laufe der Zeit verändert. Während der Einfluss des Bildungsabschlusses auf die Gesundheit in den 1970er Jahren geringer war, hat dieser Effekt in der Gegenwart zugenommen. Diese Forschungsergebnisse können zur Gestaltung der Gesundheitspolitik genutzt werden.

Abstract

This study was written to investigate the change in the correlation between health-risk behavior and educational attainment over 48 years between 1970 and 2018 in the United States. Alcohol consumption and smoking were selected explicitly as health-risk behaviors in the study. This study examined alcohol consumption and smoking behaviors, which are health-risk behaviors of adults aged 25-60 in the United States. The data used in the study were provided by the National Health Interview Survey (NHIS). As a result of the study, it was seen that there was a correlation between educational attainment and health-risk behavior. As educational attainment increased, smoking decreased while alcohol consumption increased. This study revealed how educational attainment affects individuals' health-risk behavior and its effect on change over time. While the impact of educational attainment on health was more limited in the 1970s, this effect has increased as we approach the present day. These research results can be used to organize health policies.

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1. Introduction

1.1. Background and Significance of the Study

Health-risk behaviors, such as smoking and alcohol consumption, harm human health in many ways, especially morbidity and mortality [U.S. Department of Health and Human Services, 2014]. Understanding the cause of these behaviors is crucial to developing the interventions necessary for public health. Smoking and excessive alcohol consumption are primary health problems in the United States [Australian Bureau of Statistics, 2010]. This condition is one of the leading causes of health problems such as stroke, lung disease, liver disease, heart disease, and diabetes [U.S. Department of Health and Human Services, 2010]. However, since such addictions also lead to accidents and injuries, they also significantly shorten life expectancy. Smoking and second-degree exposure to smoke cause more than 480,000 deaths in the United States each year, which means that one in every five deaths is attributable to smoking [Centers for Disease Control and Prevention, 2013]. Research shows a high correlation between educational attainment and health behaviors. As educational attainment increases, people pay more attention to their health, and the rate of exercising and eating healthy increases [Lee and Seon, 2019].

On the other hand, these people have greater access to health care and more inclusive health insurance [Lee and Seon, 2019]. A higher level of educational attainment can provide individuals with information about a higher and healthier standard of living [Lee and Seon, 2019]. After all, people with a high level of educational attainment are more likely to find better jobs than others. Their increasing socio-economic conditions make them more likely to achieve a healthier lifestyle.

This study shows how the gap between the effects of educational attainment on health widened between 1970 and 2018. The findings of this research can be used to improve public health in the future. The findings of this study can be used for government policy on what can be done to reduce smoking and alcohol consumption behavior. For example, it also shows the effects of investments in education on human health. The findings of this study give people self-awareness and help them become aware of their health-risk behavior.

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However, this study may form the basis for future studies on the correlation between health-risk behavior and educational attainment. For example, in the future, considering different demographic factors such as income level, ethnicity, socio-economic status, and gender, the correlation between educational attainment level and health-risk behavior can be examined. In addition, since this research can be repeated, changes over time can continue to be observed.

Educational attainment is correlated with socio-economic status. Due to higher educational attainment, individuals earn higher salaries and therefore have a higher standard of living. A higher standard of living also facilitates access to health services and gives access to higher-quality health services. In addition, people with higher living standards have easier access to healthier foods and can integrate sports into their lifestyle more quickly. However, people with low educational attainment have lower incomes, which means they have lower living standards. They do not have access to factors that determine a healthy lifestyle, such as access to health services, the ability to do sports, and access to healthy foods. Further studies can analyze these factors in more detail.

An essential variable on this issue are educational investments and educational policies supported by governments. Increasing the level of educational attainment of individuals is a factor that directly affects health behaviors and hazardous health behaviors. Increasing the level of educational attainment of individuals increases their living standards. Individual awareness can be improved thanks to policies and investments made by governments in education. Individuals with high awareness care about their health and avoid health-risk behaviors.

Some suggestions can be made for future research. The first of these is that it would be more efficient to conduct longitudinal studies to obtain more meaningful results so that we can have the opportunity to examine the change over time more clearly. In this way, more precise arguments can be obtained for developing policies. The policies developed will be more meaningful thanks to the accuracy of the data, which changes over time. Another important point for future research is that more solid results can be obtained by focusing on other demographic factors such as age and ethnicity, as well as the educational attainment factor examined in this study. In this way, health and education policies that will cover all segments of society can be developed. The tendency toward health-risk behaviors usually develops due to environmental factors, and public health can be improved by raising awareness of different groups of all ages, ethnic groups, and socio-economic environments. Ultimately, the correlation between educational attainment and health-risk behavior increases the standard of living of individuals, and every step taken to raise the standard of living will move individuals one step further away from

unhealthy living habits.

However, cultural and social influences are among the most critical factors. In many societies, smoking and alcohol consumption are two very important indicators of socialization. On the other hand, in many other societies, these health-risk behaviors may be completely forbidden or may not be well received due to cultural or religious reasons. For this reason, when public health policies are to be developed, culture, social norms, and religious beliefs must be taken into account. Another important demographic factor is gender. According to gender roles, women's alcohol consumption and smoking behavior are not much welcomed compared to men. As a result, men's alcohol consumption and smoking behavior are much higher than women's, while women have always stayed away from health-risk behaviors compared to men. These gender differences should play an essential role in the development of policies.

1.2. Research Questions and Objectives

This research examined the gender factor as a secondary question. For example, what are the differences in alcohol consumption and smoking factors between men and women, and how are all these consumption differences related to education? It is a known fact that women consume alcohol and smoke much less than men, and how this behavior is related to educational attainment will be examined. We will also discuss how the total correlation analysis situation changes over time.

In this study, only alcohol consumption and smoking behaviors were examined as health-risk behaviors, and the extent to which generations displayed these behaviors was examined as a secondary question. The selected generations are the Greatest Generation, the Silent Generation, Baby Boomers, Generation X, and Generation Y, namely Millennials. Since each generation was exposed to different socio-economic conditions, developed different cultures, and had different perspectives, examining the generational perspective as a secondary question was helpful in the study to understand whether the changes were periodic over the years or cultural interpretations caused by the changes.

Examining the health-risk behaviors of generations that changed over time according to their changing education brought a new and broad perspective to the study. Educational attainment is different in each generation and period. Considering the trend in health-risk behavior that changes with the change in educational attainment in terms of time and generation provides a more holistic perspective while separating health-risk behaviors into alcohol consumption and smoking, which offers a detailed analysis. The behavioral change of generations and the increase and decrease in educational attainment are also

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essential for this research. This point sheds light on the research in terms of the analysis of whether the changes are generational or temporal.

This research reveals how public tendencies towards alcohol consumption and smoking have changed over the years. It focuses on how and in what way public health, public, and educational policies that have changed over approximately 50 years have affected the tendency towards two health-risk behaviors, namely alcohol consumption and smoking, and how differences such as gender, educational attainment, and generation have affected this situation. At the same time, it has been examined from a generational perspective to observe whether changes are due to the cultural and environmental norms that generations are in or the effects of changing policies over time. The research aims to provide a holistic perspective by examining health-risk behaviors from a gender, educational attainment level, and generational perspective.

1.3. Methodology and Data Sources

This study used primary and cross-sectional data analysis to examine the relationship between health-risk behavior and educational attainment among adults in the United States. The National Health Interview Survey (NHIS) data used in this study were obtained from the National Center for Health Statistics (NCHS), which operates under the Centers for Disease Control and Prevention (CDC). NHIS is a national cross-sectional survey and is conducted annually. This study employed primary and cross-sectional data analysis to examine the relationship between educational attainment and health-risk behavior. *Primary data analysis* is a non-interventional data analysis method that examines pre-existing datasets to explore relationships between variables at a given point in time. This analysis method is a less expensive and easy research method compared to other methods [De Sanctis et al., 2022].

NHIS is a national cross-sectional survey conducted annually in the United States. It asks households about their health status, behaviors, and use of health services. There are several reasons why NHIS was chosen for this study. In this study, NHIS data were chosen as the ideal data source for this study due to their transparency, comprehensiveness, public availability, and ease of access. Among the variables to be analyzed from the NHIS data, the level of educational attainment (such as primary school graduate, high school graduate, and university graduate) is the independent variable of the research. Dependent variables are smoking status (current smoker, quit smoking, never smoked) and amount and frequency of alcohol consumption.

Data were analyzed using R statistical software. Descriptive statistics and regression

1.3. Methodology and Data Sources

analysis methods were used in this analysis. In descriptive statistics, information such as percentile distribution and mean were calculated for educational attainment level, smoking status, and alcohol consumption. In regression analysis, logistic regression was used to examine the relationship between educational attainment and alcohol consumption. These analyses allow for the observation of differences across time periods by comparing repeated cross-sectional data from different years. This study used a primary data analysis and a cross-sectional research design due to data availability and the ability to observe patterns across different time periods. Conducting large-scale and long-running survey studies such as NHIS is very costly in terms of time and resources, and getting the data directly from there provides cost savings and convenience regarding data availability. In the part where long-term patterns can be observed through repeated cross-sectional surveys, there are data from 1968 to the present in NHIS. This approach is suitable for examining patterns in the relationship between educational attainment and health-risk behaviors across different time periods. In the causality establishment part, a cross-sectional research design cannot prove causality, but it can show the relationships between variables so that we can hypothesize for future research.

The individuals in the scope of this study were adults between the ages of 25-60 between 1970-2018. The reason for choosing this age range is that it is a range in which health-risk behaviors and educational attainments are fixed, and their effects are more significant. NHIS data was filtered for analysis. ‘EDUC’ is the data set selected for educational attainment. This data is categorized as no education, elementary school, high school, and university. It was chosen to analyze the effect of educational attainment on the health-risk behavior of individuals. ‘SEX’ is the name of the gender data set used in this study. It was selected to understand how gender and educational attainment affect individuals’ health-risk behavior. The data sets ‘ALCOHOL’ and ‘SMOKESTATUS’ were chosen for health-risk behaviors. These data sets are coded in a dichotomous manner based on whether individuals consume alcohol or not and whether they smoke or not. In this study, years were coded using the ‘BASE_10_YEAR’ variable and grouped into 10-year intervals. This data set is taken to see the change in the correlation between educational attainment and health-risk behavior over time. ‘GENERATION’ is the data set showing generations. The Greatest Generation, Silent Generation, Baby Boomer, Generation X, and Generation Y generations were examined for the study. The reason for choosing generations is to examine the effect of the cultural norms developed by the generations that individuals belong to on health-risk behaviors and to understand whether they are temporal or generational.

Although alcohol consumption and smoking are the dependent variables in this study,

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educational attainment, sex, generation, and time period are the independent variables of the study. These variables were selected to test the hypotheses about the survey in a secure manner. This study used regression analysis to analyze health-risk behavior and educational attainment. The logistic regression model is used to investigate the effect of independent variables when the dependent variable is dichotomous (binary, coded as 1 and 0). In this study, alcohol consumption and smoking were coded as 1=Yes, 0=No. The first hypothesis tested in this study is that health-risk behavior will decrease as educational attainment increases. The second hypothesis is that gender will directly affect health-risk behavior, with men more prone to health-risk behavior than women. The third hypothesis is differences in the behavior of health-risk between generations. The fourth and final hypothesis is that health-risk behaviors change over time and will decrease dramatically as educational attainment increases. Independent variables were added to the model to test the hypotheses and analyze their precision. The significance of the coefficients of the independent variables was examined.

According to the results obtained from the logistic regression analysis model, there is a correlation between educational attainment and health-risk behavior. Although our hypothesis was confirmed in smoking, that is, as educational attainment increases, smoking behavior decreases, the opposite relationship was found in alcohol. As the level of educational attainment increases, alcohol consumption also increases. When the second hypothesis was tested with the gender variable, results compatible with the hypothesis were obtained. Men were found to be more prone to health-risk behavior than women. These results are consistent with the literature on the effect of gender on health behaviors. The third hypothesis is that the predisposition of generations to health-risk behavior shows excellent differences between generations. The last hypothesis stated that the correlation between educational attainment and health-risk behavior would increase over time, which was also confirmed.

1.4. Scope and Limitations of the Study

This study has some limitations. Since the participants themselves report the majority of the data, they may tend to respond very differently than they do, according to societal assumptions. This means it can lead to bias and results that do not reflect the situation. One of the limitations of this study is that the data obtained from the participants was collected through a survey method, and therefore, the participants may share incomplete information due to the possibility that they cannot remember exactly or avoid telling.

Although the dataset used in the study covers a wide time period, there are also some

1.4. Scope and Limitations of the Study

limitations. The dataset only includes whether an individual has consumed at least 12 alcoholic drinks in a year or throughout their life, but does not include information on the participants' alcohol consumption levels. Therefore, it could not be examined whether alcohol consumption levels had a negative effect on the participants' health status. The reason for choosing a dataset that could lead to limitations in this study is that it is the most comprehensive microdata source that covers such a long time period and is open to access. In this way, it has been possible to analyze the changes in alcohol consumption data over time.

In addition, the fact that factors such as socio-economic status, occupation and access to health services were not evaluated is another important limitation. Failure to maintain these variables may distort the relationship between educational attainment and risk-taking health behavior.

The health-risk behaviors examined in the study are limited and may not cover all aspects of the relationship between educational attainment and health. For data quality, the consistency of the data needs to be included; errors can be examined in more detail. In order to find meaningful results, more than educational attainment is needed, so factors such as socio-economic status, ethnicity, and geography should be examined in detail. The level of validity of the questionnaires may affect the accuracy of the results. On the other hand, participants may have different sensitivities to the health-risk behaviors evaluated in the study due to some genetic factors. This situation may cause a tendency towards the measured factors or to avoid them completely, and ignoring such factors may distort the results. Factors such as the environment experienced by the participants, air pollution and possible discomforts that may develop due to this, and their access to healthy and sufficient food are also unknown. In such cases, individual differences are ignored because they are not known, and this situation may prevent reliable results. By looking at the average level of educational attainment and average smoking, it is impossible to calculate how different individual conditions are affected. The socio-economic status variable was not examined in the study. Education, income, and occupation are required to calculate socio-economic status [Association, 2015]. Only the level of educational attainment variable was examined in the study. This study does not consider socio-economic status but only educational attainment, and this does not examine income and occupation, two important factors that directly affect the health conditions of individuals. Since income status can directly affect individuals' access to the health system, it provides important ideas about their health status. Occupation, which is one of the factors not examined, is also of great importance in itself. Work environments and work accidents that will or may occur there can also directly affect individuals' health

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behaviors. The risks that individuals working in physically dangerous jobs are exposed to in their work environments can increase their stress levels, which strengthens their health-risk behavior tendencies. Factors not considered in the study may distort the risks between health-risk behavior and level of educational attainment or prevent accurate results. On the other hand, as another factor, the health-risk behaviors examined in this study are limited, which may prevent us from obtaining meaningful results. Examining only certain health-risk behaviors may prevent us from obtaining meaningful results on health-risk behavior. For example, although smoking and alcohol consumption were evaluated, behaviors such as violence, risky sexual behaviors, and eating disorders were not evaluated. Factors such as stress management, sleep disorders, and physical activity levels were ignored. This may prevent the generalization of the results of the study. It may not be correct to interpret the results of this study from a general perspective. In order to obtain meaningful results in the study, factors such as geography and ethnicity should be considered. Different cultural norms and religious beliefs can be found in various geographical locations and ethnicities, which can lead to differences in behavioral tendencies. At the same time, geographical locations can determine the ways individuals access health services, distances, and environmental factors, and depending on these, can completely change the quality of life of individuals, which can lead to differences between individuals in terms of health-risk behaviors that are not visible in this study. Including such variables in the study makes the results more explanatory and meaningful. One of the most essential reasons educational attainment needs to be improved is the education content received. Although educational attainment is a crucial factor affecting health levels, it does not directly contribute to developing health awareness in individuals and forming risk perceptions in them. Conscious behaviors can be created in individuals by adding topics such as healthy nutrition, regular exercise, and healthy lifestyles to their curricula. Another factor that needs to be examined is the family history, health history, genetic factors, and lifestyles of individuals. These tell us a lot about their tendencies. For example, individuals with health problems in their families may be more careful about these situations, or individuals who have seen alcohol consumption and smoking in their families are more likely to engage in these behaviors. Individuals with a genetic predisposition to specific health problems may stay away from many health-risk behaviors due to health concerns, regardless of their educational attainment. On the other hand, some individuals may develop a high dependency on substances included in health-risk behavior due to their genetic predisposition. Including these effects in the research will make the study more holistic and meaningful. Environmental factors were not included in the results of this research. Although peer pressure or air pollution situations are

1.4. Scope and Limitations of the Study

essential for predisposition to health-risk behavior, the research did not calculate their effects. The results of these studies cannot be interpreted at the personal level. Changes in health and education policies also affect trends. These limitations raise new questions and directions for future research.

2. Literature Review

2.1. Definition and Measurement of Health-Risk Behavior

Health-risk behavior is defined as actions that affect or increase the risk of illness or injury that can lead to death, injury, and social problems. Typical of these behaviors include violence, smoking, alcohol, eating disorders, and risky sexual behaviors. In this study, the consumption of alcohol and smoking will be specifically mentioned [Tariq and Gupta, 2024].

The American Medical Association defines alcohol consumption disorder as "a disease characterized by a serious disorder directly related to persistent and uncontrolled alcohol consumption, resulting in detrimental effects on physical health and social behavior." Constant and regular consumption of alcohol leads to addiction and unwanted harmful symptoms. The youth alcohol consumption disorder is up to 30% in the United States. It is more common in young adults, especially men aged 18-44, than others. Other more common groups are African Americans, Asians, and Hispanics. They are those who have a mood disorder or drug use disorder [Schreiber, 2001].

The health damages resulting from alcohol consumption can be assessed in two different ways. The damages resulting from this situation are divided into two categories: acute and long-term. Acute damages can be exemplified as alcohol poisoning, traffic accidents caused by alcohol use and violence, while long-term damages can be determined as liver failure, premature brain aging and cardiovascular disorders. Alcohol consumption disorder shortens the life expectancy of individuals by approximately ten years compared to those without alcohol consumption disorder [Schuckit, 2014]. Trauma or injuries are associated with many physical and psychological disorders, such as gastrointestinal disorders such as hepatitis, heart problems such as steatosis, pancreatitis, cardiomyopathy, and cardiac arrhythmias, and continuing to consume alcohol during pregnancy can lead to hematological issues such as bone marrow suppression and macrocytosis in infants and fetal alcohol syndrome. Regular consumption of alcohol leads to anxiety, depression, and suicidal tendencies in individuals and also increases the risk of substance abuse disorders and domestic violence [Hasin et al., 2007, Fiellin et al., 2000, Schreiber, 2001, Edelman

2.1. Definition and Measurement of Health-Risk Behavior

and Fiellin, 2016].

Individuals with a mild alcohol consumption disorder respond positively to group therapy. This is not enough for individuals with moderate alcohol consumption disorder, and a combination of medications and social services can be used in addition to group therapy. In this case, to prevent relapse, it is necessary to continue drug treatment for one year and psychosocial interventions for at least 6 months. Patients with this disorder need long-term follow-up to ensure that they remain sober. Patients with this disorder require long-term follow-up to ensure that they remain sober [Reus et al., 2018].

Since alcohol consumption disorders constitute a significant threat today and are of great importance to public health, there is a need for a reliable data source on prevalence, correlations, disability, comorbidity, and treatment. Much of the epidemiology of alcohol consumption disorders is still unknown. First, we do not have clear generational information on alcohol consumption disorders in disadvantaged groups and aging cohorts such as Baby Boomers and Generation X. Another critical issue is determining the prevalence of alcohol consumption disorders in specific mental disorders [Mueser et al., 1998, Swendsen and Merikangas, 2000].

In order to understand the correlation of alcohol consumption disorder with other mental disorders, it is essential to determine the relationship of alcohol consumption disorder with other disorders and mental disorders. This will help determine how to prevent and treat alcohol consumption disorder [Hasin et al., 2007]. In this case, more comprehensive data sets than previously available are needed to examine the necessary details.

However, in current studies, the DSM-IV criteria are not taken into account sufficiently and adhered to with respect to the definition of alcohol consumption disorder. They eliminated the behavior pattern that did not meet the definition of alcohol consumption disorder and did not consider the conditions required for alcohol dependence. This has led to one-third of 12-month cases and 15% of lifetime cases not being included in the evaluation. This has returned as unmet treatment needs because they are not within the scope of the diagnosis [Hasin et al., 2007].

Smoking disorder is a common and preventable public health problem. It ranks first among the leading causes of preventable diseases and death in the United States [Camenga and Klein, 2016]. Smoking causes approximately 8 million deaths annually worldwide, of which 7 million are smokers, and approximately 1.2 million are passive smokers [GBD 2017 Risk Factor Collaborators, 2018]. Most smokers start smoking before the age of 18, which makes it difficult to quit [Camenga and Klein, 2016]. smoking is widespread among people with mental disorders. In addition, substance abuse is common among people with

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smoking disorders. In the United States, 44 percent of people with smoking disorder have a mental illness [Lasser et al., 2000]. Reports of smoking show that smoking rates are declining, but the use of alternative smoking products, such as e-cigarettes or hookahs, is increasing [Lasser et al., 2000].

Smoking is one of the most critical risk factors for lung diseases such as bronchitis [Patel et al., 2020]. Smoking promotes atherosclerosis, which leads to paralysis. Smoking causes many cancers, especially the lung, pancreas, esophagus, mouth, and larynx [Chandrupatla et al., 2017] [Nicolosi et al., 2003].

Treating smoking disorder is a public health priority because many psychological, social, and biological factors influence the progression of this disorder [Camenga and Klein, 2016]. Clinicians play the most crucial role in the prevention of smoking disorder. Both behavioral support and medication are the most effective methods of treating smoking disorders [Stead et al., 2016]. Raising public awareness about health problems caused by smoking plays an important role in eradicating smoking disorder [U.S. Preventive Services Task Force, 2013].

The approach used by the primary caregiver to regulate the smoking disorder is the 5 A method. The five significant steps of the intervention are as follows: Ask, Advise, Assess, Assist, and Arrange [Pbert et al., 2015]

2.2. Previous Research on the Relationship Between Health-Risk Behavior and Educational Attainment

Health status is one of the most critical factors that determine human well-being. Individuals with lower health and well-being have lower labor market participation and life satisfaction [Viinikainen et al., 2022]. The low public health burden on the economy is hefty, so improving public health is a priority policy in many countries. Poor health conditions are very challenging socially and economically, so prioritizing policies that regulate low health conditions is vital for well-being [Viinikainen et al., 2022].

Since health behaviors affect health, the importance of health policies is likely to improve public health as well. This thesis examines in detail the effect of education on health-risk behaviors. As health-risk behavior, we examine the relationship between smoking and alcohol consumption and educational attainment. Increasing educational attainment can improve health, and from a causal point of view, it is possible that being in better health may also increase educational attainment. In previous research, statistical studies based on causal methods have not reached a definitive conclusion between education and health

2.2. Previous Research on the Relationship Between Health-Risk Behavior and Educational Attainment

[Hamad et al., 2018] confirmed that educational attainment has varied but beneficial effects on many health outcomes [Hamad et al., 2018].

On the other hand, it concluded that educational attainment had almost no effect on health after correcting for publication bias in research [Xue et al., 2021]. It showed that studies that did not consider endogeneity tended to exaggerate the relationship between education and health. These studies have shown that the relationship between education and health is not as conclusive as we think [Viinikainen et al., 2022].

On the other hand, past studies have found significant negative correlations between training and risky behaviors. It found that smoking behavior was much lower in individuals with a high level of educational attainment than in other education levels. As a result of these studies, it was shown that a high level of educational attainment contributed to a good diet choice and eating habits. [Cawley and Ruhm, 2011, Cutler and Lleras-Muney, 2010, De Irala-Estévez et al., 2000].

On the other hand, the main difficulty in such empirical studies is that the negative correlation may also be manipulative through unobservable behaviors [Farrell and Fuchs, 1982]. Looking at it from another perspective, we can also explain the negative correlation by establishing reverse causation. Suppose an individual has been exposed to high levels of alcohol consumption during adolescence. In that case, they are much more likely to have low educational attainment later in life [Cook and Moore, 1994, Renna, 2007]. Suppose the impact of variables not considered when examining the relationship between education and health is more significant than estimated. In that case, this leads to the fact that educational investments made or to be made to increase health behaviors do not achieve the desired results in improving public health. When we look at the studies on this subject in general, we see a negative relationship between educational attainment and health investment [Arendt, 2005, Jensen and Lleras-Muney, 2012, Jürges et al., 2011].

In another study, a relationship was established between a high level of educational attainment and high alcohol consumption [Cutler and Lleras-Muney, 2009]; however, this relationship may not be causal [Braakmann, 2011, Clark and Royer, 2013, Fletcher, 2015]. Education can reduce excessive alcohol consumption and lead to a healthier pattern of alcohol consumption [Li and Powdthavee, 2015]. Findings from such MR studies have shown that education reduces smoking and may introduce a new pattern of drinking [Gage et al., 2018, Davies et al., 2019]. Research shows that as the level of educational attainment increases, drinking behavior also increases [Davies et al., 2019, Zhou et al., 2021]. However, it is worth noting that the frequency of consumption, not the amount of alcohol drunk, has increased [Rosoff et al., 2021, Zhou et al., 2021]. Binge drinking is observed at a low rate among highly educated people [Rosoff et al., 2021]. Studies have

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shown that alcohol consumption may increase due to the higher disposable income of educated individuals. Still, these individuals have a high awareness of binge drinking and social norms, which limits and reduces the amount of drinking during drinking frequency [Rosoff et al., 2021].

On the other hand, some studies conducted among young people suggest that some psychological conditions can increase their behaviors, such as smoking and alcohol consumption. A 1997 study of 15-year-old by the World Health Organization showed that a lack of self-confidence negatively affects decision-making. As a result, as the lack of self-confidence increases, young people may increase their tendency to smoke, drink, and consume drugs with the need to belong to social groups [Glendinning and Inglis, 1999].

There has been very little research on adolescents with mental disorders and smoking. On the other hand, it has been found that when additional psychological support and treatment are added to standard procedure treatment in adults with depression, withdrawal decreases, and positive developments are recorded in treatment outcomes [Camenga and Klein, 2016]. On the other hand, such studies cannot be found for different age groups. Despite many regulations made within the scope of smoking, the issue of preventing passive smoking is still a significant problem. When the data is examined, although smoking has decreased over the years, e-cigarette and hookah use is increasing day by day. Young people with mental disorders are the most vulnerable group in these issues [Camenga and Klein, 2016].

Determining whether alcohol consumption and smoking are caused by mental disorders or educational attainment is of great importance in developing public health policies. health-risk behaviors resulting from mental disorders can be a chronic problem in terms of public health because they cannot be resolved by educational attainment.

2.3. Theoretical Frameworks and Hypotheses

This study will examine the correlation between health-risk behavior and educational attainment in terms of social cognitive theory and human capital theory. According to social cognitive theory, individuals with high educational attainment have more information about healthy living and healthy eating patterns than individuals with low educational attainment. For this reason, individuals with high educational attainment are expected to turn to healthier behaviors. According to another theory, human capital theory, individuals with high educational attainment also have higher access to health services, and thanks to this and other factors brought about by the rising standard of living, their health status is better and they have a healthier lifestyle. The central hypothesis

2.3. Theoretical Frameworks and Hypotheses

of this study is that there is a negative correlation between educational attainment and health-risk behaviors in the United States and that individuals will move away from health-related risky behaviors as educational attainment increases. Several sub-hypotheses have been tested in this research. The first of these is hypotheses from a temporal point of view.

Regarding temporary outcomes, the negative correlation between educational attainment and health-risk behavior increased from the 1970s to 2018. In particular, this relationship may show other differences between different age groups; for example, the negative correlation may be more robust in younger generations. According to socio-economic status hypotheses, the correlation between educational attainment and health-risk behavior of individuals with higher socio-economic status is weaker. In individuals in low-income households, the correlation between educational attainment and health-risk behavior may be more robust.

All these hypotheses have three main bases. These are social cognitive, human capital, and social inequality theories. According to the theory of social inequality, an individual's level of educational attainment generally indicates the level of social inequality they are exposed to. If an individual's educational attainment is low, they are more likely to live in environments with more health-risk behaviors. In the past, many studies have been conducted examining the correlation between educational attainment and health. When this situation is summarized in general terms, the increase in educational attainment is a situation that increases the knowledge and skills of individuals. The living conditions of individuals whose knowledge and skills increase, together with the increasing income, improve and employment opportunities increase. As a result of this whole process, the individual has access to more resources. In this context, the increase in educational attainment distances individuals from health-risk behavior as much as possible. On the other hand, another aspect of educational attainment deepens inequalities [Weber, 2009].

When this situation is examined from a sociological perspective, it acts as a separator that separates social classes. In this context, educational attainment offers many opportunities and widens the gap between social classes. Since there is great inequality of resources between social classes, the size of the resources required to access quality educational attainment also prevents all social classes from receiving equal quality education [Grodsky and Jackson, 2009, Houle and Warner, 2017, Nash, 1990]. This leads to the difference in health-risk behavior between classes. All these situations cause individuals to have different educational attainment experiences according to their social class. Past research often ignores the aspect of educational attainment that increases social inequality and deepens the gap between health behaviors. The family's socio-economic status shapes

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an individual's education life [Breen and Jonsson, 2005]. While individuals in lower socio-economic classes have a lower rate of completing their university education, it is a more common behavior in upper classes to complete university education. Fifty percent of the families of individuals who have completed their university education by the age of 24 come from the top quartile social class. On the other hand, only 10 percent of the children of families in the lowest social class can complete their university education by 24 [Cahalan et al., 2016]. This situation, which reveals the inequality of opportunity in education, actually indirectly reveals the health inequality that will occur in society in the future. Since the policies developed as a result of the research conducted so far do not take into account the concept of social inequality deepened by education, it shows that individuals who grow up in socio-economically advantaged families benefit more from existing policies and interventions, which unintentionally increases inequality in existing policies [Johnson et al., 2016].

Another essential factor that should be mentioned is that these behaviors that will lead to health-risk behaviors are usually acquired before university education [Maralani, 2014]. Individuals who exhibit health-risk behaviors separate themselves from their peers and families, and this is an acceptable situation in the environment where they are and their abilities are [Vuolo and Staff, 2013]. It is known that those with high educational attainment stay away from health-risk behaviors, but there is no definitive data that this is due to education. The 2005 report published by the European Student Union brought a different perspective and revealed different results than was known. According to the published report titled "Commodification of Education," higher education institutions have begun to be perceived as service providers, and students are seen as human capital. Students are moving away from actively participating in higher education institutions and focusing only on areas where they can prepare for the labor market and gain financial benefits after graduation. When this situation is examined socially, this unhealthy competitive environment undermines the solidarity and cooperation environment experienced among students [Union, 2011].

On the other hand, this hostile and highly competitive environment has a negative permanence on students' procrastination. The competitive environment experienced at every level of educational attainment, especially at university entrance and continuing with the grading system throughout education, creates winners, damages, and an unhealthy learning environment [Cahalan et al., 2016]. These can also lead to high alcohol consumption due to increased stress levels.

2.4. Summary of Gaps and Limitations in the Literature

Although the correlation between health-risk behavior and educational attainment has been considered from many different perspectives from the past to the present, there are still many research gaps. When we examine previous studies, we find some similarities. Studies have generally been reviewed depending on age group, race, and gender. Separate studies have been conducted that generally focus solely on alcohol consumption or smoking, not necessarily as a health-risk behavior. Some studies, on the other hand, focused only on genetic or environmental factors and did not examine other traits. One of the other limitations of the studies is that they remain regionally bound. Usually, the focus is on a country, a district, or a state, and only a little research has been conducted worldwide. The correlation between educational attainment and health-risk behavior may change over time, but there are few long-term studies in this direction, which is crucial for a more comprehensive and forward-thinking approach.

In some cases, there has been much focus on specific age, gender, race, or region. This prevents us from finding generalizable results. Finding generalizable results is significant for the health policies that governments and global-scale institutions will create in the coming years. On the other hand, the differences in measurement methods are also substantial. Research often uses different measurement methods, statistical formulas, and data sets, making it difficult to compare the studies. Although most research is cross-sectional or cohort studies, experimental designs yield more robust results, which leads to a significant problem regarding the need for more research diversity. In this study, the psychological state of the individuals was not taken into consideration; their mental disorders are unknown. Situations such as self-esteem, self-sufficiency, and anxiety level were not taken into consideration. Ignoring these situations may lead to the failure to obtain healthy results in the study.

On the other hand, there are many research gaps. The data sets we primarily deal with are self-reported data. Self-reported data is usually reported by the participants, which can always lead to bias and recall errors. Some studies have focused on relationships at the individual level, so the generalization of the results to society needs to be higher. There may also be many things that could be improved in study designs. Some studies are only observational, so it can be not easy to establish causality.

On the other hand, studies based on experiments are much more likely to have strong results. Past research has generally focused on young adults and middle-aged. There are not many studies that focus on the elderly population. For this reason, there is not much information about the correlation in the elderly population. Studies focusing

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on the psychological state of individuals are also minimal. Many psychological factors can cause a predisposition to health-risk behavior. For example, Many conditions, such as self-worth, self-efficacy, health anxiety, and personality disorders, can be correlated with health-risk behavior. Still, current studies are far from considering the research's psychological aspects. Research has made little mention of the impact of the social environment. However, behaviors such as smoking or alcohol consumption are habits that are started and continued, especially under the influence of the environment. Therefore, the effect of the social environment should be scrutinized. Particular attention is paid to how communities modulate social relationships through addictive behaviors.

One of the important points of the study is that it is not known how effective the health policies developed are in increasing or decreasing health-risk behaviors an this uncertainty reveals the need for further research. Understanding how effective health policies are regarding health-risk behavior is one of the first questions that must be answered to protect future generations from harmful behaviors.

There are many additional limitations in research. Different measurement methods and calculations were often used in each experiment and research, posing a challenge for comparing research. Although studies are ongoing to determine which data collection method is more reliable, data quality is the most critical factor in the reliability of research results, making the need for more objective research a priority. Unbiased findings are also very important in the research literature. Publishing consistently positive or significant results in particular introduces bias into the literature.

Another area for improvement is examining the correlation between education and health. School success is not taken into account at all or is treated as a contributing variable. Since research is usually advanced based on the graduation degree earned, it is tough to find studies on how each increasing year affects it [Zajacova and Lawrence, 2018]. Someone who has received one year of education has much more knowledge than someone who has never received any education, that is, someone who has studied for 0 years. These provide a lot of knowledge, such as literacy and essential math skills, and change the lives of individuals in many ways. On the other hand, graduating from high school, starting university, and leaving it unfinished can make many differences. For example, the knowledge obtained at the university can increase the health level of individuals, or dropping out of university, being stigmatized by society as having dropped out of the university and not being able to earn a degree despite the debts that this brings are serious factors [Holmes and Zajacova, 2014, Link and Phelan, 2006]. It increases the stress level of individuals and can push them to consume more alcohol and smoking than their peers who are only high school graduates. We cannot examine such nuances since

2.4. Summary of Gaps and Limitations in the Literature

we are based only on degrees during the research.

Identifying why education is beneficial for health can be very useful for future health policies. Mortality rates gradually decrease as educational attainment rises. Sharp decreases in mortality rates are observed in the graphs, especially at points such as high school diplomas and university diplomas. This means that prolonging education may not be a sufficient factor in the absence of diploma attainment [Montez et al., 2012, Hayward et al., 2015]. These researches may give different results from the past regarding today's education and health policies to be made accordingly. For this reason, it is helpful to conduct up-to-date research and determine new policies.

A college degree is one of the minimum requirements for entering the middle class in the United States. Stepping into university is not only a diploma but also a marker that determines the economic and social status of the individual. The individual has to obtain a minimum four-year university degree to live a financially comfortable life and access good job opportunities. The "some college" group can be used in research to describe adults who have started but not finished college. These individuals began college, gained university experience, and did not receive a degree. This group is essential in educational research [Montez et al., 2012]. This group is necessary because of their proportion in the population, and there are usually no separate studies for them. In the United States, 30% of non-elderly adults make up about 54 million people. This situation brings with it many question marks, gaps, and limitations. Even if the diploma is not obtained, do the years spent or the credits completed have an effect? Are there any differences in terms of private or public universities? How does having college debt affect both school success and health? There are also many challenges in the education measure. We generally do not have data on how many years it takes for someone to complete four years of university education, so we do not know how much time spent impacts health-risk behavior after the diploma is issued. However, new research has begun on these issues.

Data collected in the 1997 National Longitudinal Youth Survey (NLSY97) include data collected on credits earned and time spent, which reveal more up-to-date and meaningful results [Walsemann et al., 2013]. Research conducted in 2016 using NLSY97 data found exciting results. According to this study, there was a gradual improvement in health due to the gradual increase in the duration of education [Duke and Macmillan, 2016, Lynch and Von Hippel, 2016]. Researchers interpreted this to mean that the relationship between educational attainment and health is not directly causal but is generally based on a cognitive and social environment. Another finding is that the relationship between education and health cannot be seen simultaneously. Since education is a long-term development process, the impact of education and its effect on health cannot be observed

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in the short term. For this reason, we need more research to understand the impact of educational attainment on health [Hessel and Simon Thomas, 2016].

3. Methods

3.1. Study Design and Data Collection

The data of this study were taken from the IPUMS Health Survey. IPUMS stands for Integrated Public Use Microdata Series and is a project that stores data sources that can be used for health-related research in the United States and provides microdata for research that can be used in many fields such as social sciences, economics, demography, psychology, sociology, and more. IPUMS Health Survey, on the other hand, is a sub-branch that includes specifically health-related data. The data sets in the IPUMS Health Survey are obtained from national surveys and health research, combined into a single source, and made accessible to researchers. The various datasets used by researchers to develop health policies allow researchers to compare and analyze data. Due to the diversity and breadth of the datasets, researchers can easily compare different years and regions, perform statistical analyzes, identify trends, and investigate social determinants. IPUMS Health Survey is the primary source for conducting health-related research, preparing policies, and measuring the effects of health policies.

On the other hand, IPUMS is affiliated with the University of Minnesota's Institute for Social Research and Data Innovation and is led by Regents Professor Steven Ruggles. It provides social and economic data, censuses, surveys, and data from every corner of the world integrated into time and space. Data documentation makes it easier to analyze data by incorporating data integration, exchange, review, compare, and integrate the obtained data in the context of family and community. These data and services are made free of charge to researchers worldwide. Over the past 25 years, IPUMS has received 70 federal grants and contracts worth over \$140 million. This grant is used to improve, disseminate and integrate data. The IPUMS includes data produced by various agencies, including the Census Bureau, the Bureau of Labor Statistics, the National Science Foundation, the National Center for Health Statistics, the Centers for Disease Control, and the National Aeronautics and Space Administration [IPUMS, 2025]. IPUMS creates the world's largest accessible census microdata database in collaboration with national statistical agencies, nine national archives, and three genealogical organizations.

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It contains over a billion records from censuses in the United States from 1790 to the present, over a billion censuses of more than 100 countries, and many other data. IPUMS currently has microdata identifying 1.4 billion people. IPUMS is also the first structured metadata system to integrate different datasets.

IPUMS Health Surveys provides free data for research purposes. It collects data from two critical sources based entirely on the self-report method. These resources are the National Health Interview Survey (NHIS) and the Medical Expenditure Panel Survey (MEPS). NHIS is an ongoing self-report survey from 1957 to the present on health-related issues such as health status, health behaviors, and access to health services. MEPS is [IPUMS, 2025]. Health expenditure is usually a survey of the economic aspects of the healthcare system, such as healthcare use. Both surveys provide a large set of data on understanding health behaviors and their financial aspects [IPUMS, 2025].

This study used a cross-sectional observational research design to examine the relationship between educational attainment and health-risk behaviors (alcohol consumption and smoking) among adults over 25 years of age in the United States. Cross-sectional studies are conducted on the entire population at risk for any health problem or on a sample group selected from here, as well as the frequency of occurrence of any disease or health problem at the time of the examination. In other words, it is done to determine its prevalence. The relationship between the examined health problem or disease and various socio-demographic factors and possible factors that cause the emergence of the health problem is investigated. Thus, the cause-effect relationship is investigated simultaneously in a certain period. Cross-sectional research is a social diagnostic tool that is used to determine the extent of public health problems and priorities in service. It is the most widely used research method to obtain data in planning, evaluating, and directing health services. In cross-sectional studies, representative analytical results can be obtained for the society because the entire population is at risk or a selected sample is studied [Setia, 2016].

The data used in this study are from 1970 to 2018, and information obtained from different individuals was used for each year. This cross-sectional approach is ideal for understanding how general health behaviors and educational attainment in society change over time. Cross-sectional research designs do not track individuals over time but aim to calculate trends from independent samples obtained yearly. This research focused specifically on the health behaviors of NHIS. The main factors selected from health-risk behavior were alcohol consumption and smoking. These health-risk behaviors are related to educational attainment and affect the health of individuals. The primary data set of these analyses is alcohol consumption and smoking behavior.

3.1. Study Design and Data Collection

Data from 660,376 participants were examined in the study. Data from 640,571 participants were analyzed for smoking, and 478,127 participants were analyzed for alcohol. Of the participants, 297,876 are male and 362,500 are female. From a generational perspective, 28,432 is Greatest, 119,245 is Silent, 290,726 is Boomer, 168,078 is Gen X, and 53,895 is Gen Y. The borns between 1910-1924 were the Greatest, the borns between 1925-1945 were recorded as Silent, the boomers between 1946-1964, Generation X from 1965-1979, and the borns between 1980-1994 as Generation Y [McCrindle, 2022].

Category	Number of Participants
Total Participants	660,376
Smoking Analysis Participants	640,571
Alcohol Analysis Participants	478,127
Gender Distribution	
Male	297,876
Female	362,500
Generation Distribution	
Greatest Generation (1910-1924)	28,432
Silent Generation (1925-1945)	119,245
Baby Boomer (1946-1964)	290,726
Generation X (1965-1979)	168,078
Generation Y (1980-1994)	53,895

Table 3.1.: Demographic Distribution of Participants

In the surveys, the questions asked of the participants were whether they smoke and, if so, how often they smoke. Similarly, in the case of alcohol, the annual frequency of alcohol consumption of the participants or whether they consumed alcohol was examined. The level of educational attainment was similarly examined. Participants were asked about their most recent degree. The categories are divided into no education, primary, high school, and college, while categories such as master's, doctorate, or post-doc earned after college are included in the college.

NHIS data are weighted to better represent the population of the United States and are collected from a different sample group each year. The survey participants varied in age, gender, race, educational attainment, and regional distribution. People over the age group of 25 are preferred in this study because they are generally adults who have completed their educational attainment and can shape their decisions later in their lives. However, people usually complete their college education by the age of 25. Individuals under the age of 25 were not preferred because the last degree earned by the participants who graduated

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from high school and attended the university was high school graduation, but the fact that they continued their lives in the university environment may cause a calculation error, such as high school graduates under the age of 25 showing high health-risk behavior due to environmental conditions.

On the other hand, this study examined how health-risk behavior was related to different demographic variables such as age and sex. It looked at the correlation of educational attainment with these variables because NHIS collects data from a large sample every year. We have analyzed data from millions of people over 48 years. The generalizability of the results is very high because of the sample size. In addition, it allows us to get more reliable results on the correlation between health-risk behavior and educational attainment.

Considering the size of the data set, this study aims to analyze both the temporal change of the data and the effect of different levels of educational attainment on different health-risk behaviors. When these two approaches are combined, we can examine how varying the level of educational attainment impacts the changes in health-risk behavior over time. In order to reach more meaningful results, certain time intervals were combined and years were examined by dividing them into 10-year periods. This aims to simplify the time series and see the ten-year trends. In this way, we can easily see individuals' tendencies and behavior patterns in the 1970s, 1980s, 1990s, 2000s, and 2010s. Analysis was performed for each ten years, and the results for each 10 years were compared. It was evaluated as a cross-sectional study looking at different 10-year groups to determine whether the effect of educational attainment on health-risk behavior increased or decreased, and these data were examined together with other demographic groups.

All data in this study were taken from a public platform, the NHIS IPUMS Health Survey. All data collected on this platform are shared anonymously to protect participants' privacy. The identities of the participants were kept confidential and only demographic information was used to analyze health-risk behaviors. NHIS informed the participants when collecting this data and the participants signed the consent forms. NHIS has been highly ethical when it comes to data privacy. However, this study did not need an additional form of ethics because the data used were collected and anonymized in advance.

One of the significant limitations of this study is the cross-sectional data structure. Since it cannot monitor the same individuals over time, it cannot monitor the direction in which individual behavior changes. However, a large sample size and time series analysis enable the study of general trends and changes at the population level. In this way, we can achieve more generalizable results. In this study, the cross-sectional design was aimed and sufficient because it was desired to learn the effect of educational attainment on

health-risk behaviors on the social level, not for individual reasons.

3.2. Variables and Operationalization

The study operationalized the variables in a data-driven way to examine the correlation between educational attainment and health-risk behavior. The variables in the study, namely educational attainment and alcohol consumption and smoking behavior, were carried out using a particular method. Educational attainment is the independent variable of this study, and this variable is the primary variable affecting the health-risk behavior of the participants. Educational attainment was measured based on NHIS survey responses and refers to the highest level of education completed. The dependent variables of this study are the alcohol consumption and smoking behavior of individuals, that is, the category of health-risk behavior. These variables were accepted as a reflection of the health-risk behaviors of individuals. These two variables were operationalized by considering the data collection processes and their specific methodological changes. Variables such as EDUCREC2, HIGRADE2, ALC1YR, SMOKESTATUS1, SMOKESTATUS2, AGE, and SEX are data columns from the National Health Interview Survey (NHIS). The meaning of EDUCREC2 is Educational Recode 2; this is a compound variable that evaluates the level of educational attainment. This variable is a combined, renamed form of the HIGRADE2 and EDUC variables. HIGRADE2 measures the highest school degree of participants or the number of years they completed between 1968 and 1996. EDUC determines the participants' highest level of educational attainment according to the highest diploma or degree from 1997. EDUCREC2 is a more compatible and unified version of these two variables over time, recoded to be a comparable variable. By combining these data collected at different times, it was aimed to obtain a consistent variable that remained consistent over time, thus making it easier for researchers who want to examine the interaction of change over time with other categories. EDUCREC2 harmonizes the categories of the HIGRADE2 and EDUC variables and assigns compatible codes to them. In this way, the data obtained through HIGRADE2 between 1968 and 1996 and the training data obtained through EDUC since 1997 become comparable in the same data group. 0 = NIU, 10 = Never attended/kindergarten only, 20 = Grade 1, 2, 3, or 4, 30 = Grade 5, 6, 7, or 8, 31 = Grade 5, 6, or 7, 32 = Grade 8, 40 = Grade 9, 10, 11, or 12, 41 = Grade 9, 10, or 11, 42 = Grade 12, 50 = 1 to 4 years of college, 51 = 1 to 3 years of college, 52 = 1 to 2 years of college, 53 = 3 to 4 years of college, 54 = 4 years of college / bachelor's degree, 60 = 5+ years of college. It is encoded as 0 ve 10 No Education; 20, 30, 31, 32 Primary; 40, 41, 42 High School; 50, 51, 52, 53, 54, 60 College.

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When converted to numerical values, No Education = 0, Primary = 1, High School = 2, College = 3, Otherwise = 4.

EDUCREC2 Code	Education Level	Numerical Value
0, 10	No Education	0
20, 30, 31, 32	Primary	1
40, 41, 42	High School	2
50, 51, 52, 53, 54, 60	College	3
Otherwise	Undefined	4

Table 3.2.: EDUCREC2 Encoding and Numerical Conversion

NHIS measured participants' alcohol consumption habits based on a series of questions. Although the data collected on alcohol consumption in this study are broadly comparable over time, some changes in the survey questions may need to be revised in terms of the comparability of the analyses. The question about alcohol use in this study focuses on whether participants had consumed 12 or more alcoholic beverages in the past 12 months. In the NHIS data, this question was identified as the ALC1YR variable. For participants who have never consumed alcohol in the past year (ALCANYNO = 0 or ALCAMT = 0), the ALC1YR variable indicates whether the person has had at least 12 drinks during any given year of their life.

Year	Alcohol Consumption Measurement
1983, 1985, 1990	Participants asked if they had consumed more than 12 alcoholic beverages in their lifetime.
1988	Included participants who had consumed more than 12 alcoholic beverages in their lifetime but not in the past 12 months.
1997-2018	All participants answered alcohol consumption questions, regardless of past consumption history.
2020-2022	Focused on individuals who did not consume alcohol in the past year (ALCANYNO = 0 or ALCAMT = 0).

Table 3.3.: NHIS Alcohol Consumption Data Collection Changes Over Time

In 1983, 1985, and 1990, participants were asked if they had consumed more than 12 alcoholic beverages in their lifetime to examine individuals with regular alcohol consumption. In 1988, the focus was on individuals who had consumed 12 drinks in the past but had not consumed any in the last 12 months. The aim here is to focus on people who have a long-term history of alcohol but whose alcohol consumption has not been very

3.2. Variables and Operationalization

high in recent years. From 1997 onwards, all individuals over the age of 18 were included in the survey, regardless of their history of alcohol consumption.

Although it was not examined in this study, for the convenience of future research, for the years 2020, 2021, and 2022, individuals who did not engage in alcohol consumption in the past year ($ALCANYNO = 0$ or $ALCAMT = 0$) were focused and the alcohol consumption habits of the individuals were examined. This information shows how data collection has changed in the past years, with the focus on which different groups have focused. This allows different alcohol consumption groups to be compared.

The data used in this study has remained constant despite some minor changes in the definition of the alcohol consumption variable over the years. In the surveys conducted between 1983 and 2018, the principle of whether the participants consumed at least 12 drinks in any year was adhered to. Therefore, despite the minor differences in the survey questions, the data were easily combined and analyzed. The only minor differences mentioned were that the post-1997 survey text gave examples of drink types: "Included are liquor such as whiskey or gin, beer, wine, wine coolers, and any other type of alcoholic beverage." [Centers for Disease Control and Prevention (CDC), 2020]. The time period of the research was up to 2018, and data from 2020 and later were not included in the research.

SMOKESTATUS1 Category	Code
Never smoked	10
Current smoker	20
Former smoker	30
Former regular smoker	31
Former occasional smoker	32
Unknown	-
Unknown if ever smoked 100 cigarettes	-
Smoked 100 cigarettes, unknown if currently smoke	-
Reclassification	
Non-smoker (Never, Former, Former Regular)	10, 30, 31
Smoker (Smoked 100 cigarettes, Current)	20

Table 3.4.: SMOKESTATUS1 Classification and Reclassification

In this study, the variables SMOKESTATUS1 and SMOKESTATUS2 are the variables that classify the smoking behaviors of the individuals. These variables help identify understand the past or present smoking habits of participants over the age of 18. The categories used by SMOKESTATUS1 regarding the smoking status of the participants

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SMOKESTATUS2 Category	Code
Current smoker	10
Current daily smoker	11
Current someday smoker	12
Current smoker, unknown frequency	13
Former smoker	20
Never smoked	30
Has smoked, current smoking status unknown	-
Reclassification	
Smoker (Current, Daily, Someday, Unknown frequency)	10, 11, 12, 13
Non-smoker (Former, Never)	20, 30

Table 3.5.: SMOKESTATUS2 Classification and Reclassification

are as follows: "never", "current", "former", "former regular smoker", "former occasional smoker", "unknown" and "unknown if ever smoked 100 cigarettes", and "smoked 100 cigarettes, unknown if currently smoke". In SMOKESTATUS1, the numerical values corresponding to smoking status are 10 = Never smoked, 20 = Current smoker, 30 = Former smoker, 31 = Former regular smoker, 32 = Former occasional smoker. Then 10, 30, and 31 were coded as non-smoking [NHIS, 2025]. The category of smokers is categorized as "those who have smoked 100 cigarettes in their lifetime" and "those who are still smokers." Since 1991, current smokers have been divided into two categories: everyday smokers and some day smokers. After 1992, some things needed to be more consistent in the classification of the smoking group, as the questions were asked in two parts.

The data were analyzed by considering the differences between the data before and after 1992. The categories in SMOKESTATUS2 are current smoking status in the current smoker, everyday current smoker, someday current smoker, current smoker–unknown frequency of smoking, and also indicates former smoker, never smoked, and "has smoked, current smoking status unknown.". In SMOKESTATUS2, the numerical values corresponding to the smoking status are 10 = current smoker, 11 = current daily smoker, 12 = current someday smoker, 13 = current smoker, unknown how often smoke, 20 = former smoker, 30 = never smoked [NHIS, 2025]. Then 10, 11, 12, and 13 were coded as smokers, 20 and 30 as nonsmokers. These classifications varied between 1991 and 1992, and after participants said they smoked, they were asked if they smoked every day or some days. This change in the questionnaire format in 1992 resulted in a 1% increase in smokers. The reason for this is related to the fact that the participants who could have been included

in the non-smoking category in previous years are included in the smoker category with the classification system of the new questions. SMOKESTATUS1's data cover 1970, 1974, 1976-1977, 1985, 1987, 1990-1995, and 1997-2003, while SMOKESTATUS2's data only covers 1991-1995, 1997-2023. Only the part up to 2019 was included in our study.

However, the data classification methods for both variables have changed over time, especially in the years before 1991 and 1992, and the measurements made on smoking habits have changed significantly after 1992. The results were analyzed considering these differences. It is also taken into account that these classifications may change over time. It should always be considered that the variables in the classification of the analysis findings can seriously impact the results.

3.3. Statistical Analysis Techniques

The mathematical formulas used to examine the relationship between health-risk behavior and educational attainment will be examined in this part of the research. These formulas show the situations such as data processing, combining data, renaming categories, standardizing, dividing the time period into 10-year periods. In our research, the data was selected and filtered appropriately before starting the data analysis. The purpose of this is to optimize the analysis of the data set. Participants were separated according to age groups and gender. The formula for the data set in which participants are separated according to gender and age is as follows.

$$D_s = \{(Y_i, E_i, A_i, S1_i, S2_i, G_i, C_i) \mid 25 \leq G_i \leq 60 \text{ and } C_i \in \{1, 2\}\}$$

D_s : Dataset, Y_i : Year, E_i : Educational Attainment, A_i : Alcohol Consumption Status, B_i : Birth Year, D_i : Decades, n : Number of Individuals, i : Individuals, $S1_i/S2_i$: Smoking Status, G_i : Age, C_i : Gender(1=Male, 2=Female)

Thanks to this filtering, people between the ages of 25 and 60 and those whose gender is male or female were selected. In order to make more specific and pinpoint analyses, it is necessary to make a restriction based on gender and age. In the analysis, the reference point in the educational attainment section is "No Education". In the generations, the reference point is "Greatest Generation". The next point that was progressed in the research was the merging of the subcategories in smoking behavior. The smoking behavior category in this research has two variables and these variables are named as S1 and S2. The formula below shows the merging process of the variables. The formula shown below

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was used to analyze the smoking behavior of the participants. Therefore, the participants were divided into two categories as smokers and non-smokers, and the participants shown with NA are the participants whose smoking behaviors we do not have information about or have incomplete information about, and their data were not included in this study. When the formula below is examined, the category representing participants with smoking behavior is shown as 1, while the value 0 is preferred to represent the category of participants without smoking behavior.

$$S_i = \begin{cases} 1 & \text{if } S1_i \in \{20\} \text{ or } S2_i \in \{10, 11, 12, 13\} \\ 0 & \text{if } S1_i \in \{10, 30, 31, 32\} \text{ or } S2_i = 20 \\ \text{NA} & \text{otherwise} \end{cases}$$

Educational attainment is one of the main variables in study. The level of educational attainment of the participants is divided into various categories. Educational attainment has a prominent place in the health-risk behavior preferences of individuals; for this reason, categorizing the educational attainment of participants is very important to understand the correlation. The clear separation of educational attainment increases the reliability of the analysis. The aim is to make it easier to compare and analyze data by standardizing data. The formula for standardization, where different numbers are given to different educational attainments, is as follows.

$$E_i = \begin{cases} 0 & \text{if } E_i \in \{0, 10\} \\ 1 & \text{if } E_i \in \{20, 30, 31, 32\} \\ 2 & \text{if } E_i \in \{40, 41, 42\} \\ 3 & \text{if } E_i \in \{50, 51, 52, 53, 54, 60\} \\ 4 & \text{otherwise} \end{cases}$$

Another variable is the alcohol consumption variable. Alcohol consumption status occupies an ample space to calculate health-risk behavior in individuals. Performing a thorough analysis of this situation is of great importance in terms of public health policies that can be developed in the future. In the formula = 0 indicates individuals who do not use alcohol, while = 1 indicates those who use alcohol.

$$A_i = \begin{cases} 0 & \text{if } A_i = 1 \text{ (NO)} \\ 1 & \text{if } A_i = 2 \text{ (YES)} \end{cases}$$

Participants are divided into generations according to their year of birth, calculated as

follows:

$$B_i = Y_i - G_i$$

Based on their birth years, individuals are categorized into the following generational cohorts:

- Greatest Generation ($1910 \leq B_i \leq 1924$)
- Silent Generation ($1925 \leq B_i \leq 1945$)
- Baby Boomers ($1946 \leq B_i \leq 1964$)
- Generation X ($1965 \leq B_i \leq 1979$)
- Generation Y (Millennials) ($1980 \leq B_i \leq 1994$)

The years are grouped into 10-year periods, where (D_i) represents the decade for each individual:

$$D_i = \lfloor \frac{Y_i}{10} \rfloor \times 10$$

The smoking rate (SR) for each level of educational attainment and gender group is calculated as:

$$SR = \frac{\sum_{i=1}^n S_i}{n}$$

Similarly, the rate of alcohol consumption (AR) for each level of educational attainment and gender group is calculated as

$$AR = \frac{\sum_{i=1}^n A_i}{n}$$

The four logistic regression models used in the research are examined in the following.

$$\begin{aligned} \log \left[\frac{P(\text{ALCOHOL} = \text{YES})}{1 - P(\text{ALCOHOL} = \text{YES})} \right] &= \alpha + \beta_1(\text{SEX}_{\text{FEMALE}}) + \beta_2(\text{EDUC}_{\text{PRIMARY}}) \\ &+ \beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}}) + \beta_4(\text{EDUC}_{\text{COLLEGE}}) \\ &+ \beta_5(\text{BASE_10_YEAR}) \end{aligned} \tag{3.1}$$

Logistic Regression Model for Alcohol Consumption (Eq 3.1)

3. Methods

The model is a logistic regression model developed to analyze certain socio-economic and demographic factors related to alcohol consumption. This formula, which was developed to determine the probability of individuals consuming alcohol, calculated the effects of independent variables such as generation, educational attainment and gender. This formula, which has a two-category structure and whose dependent variable is alcohol consumption, is a logistic regression model used to analyze nonlinear data. In this model, alcohol consumption is a probability function; the logarithmic ratio of the probability is taken and modeled with independent variables. The descriptions of the variables are as follows: α : This is a fixed variable and shows the state of the alcohol consumption variable when it is not affected by the other independent variables, $\beta_1(\text{SEX}_{\text{FEMALE}})$: Shows the gender factor and measures the effect of being a woman on alcohol consumption, $\beta_2(\text{EDUC}_{\text{PRIMARY}})$, $\beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}})$, $\beta_4(\text{EDUC}_{\text{COLLEGE}})$: These are factors included in educational attainment. They were used to test for differences in alcohol consumption according to educational attainment. - $\beta_5(\text{BASE_10_YEAR})$: The purpose of this variable is to group years into 10-year periods. It allows determining the effect of time on alcohol consumption. It reveals the effect of each 10 years on alcohol consumption. This model establishes a relationship between alcohol consumption and independent variables. Shows the probability that an individual will consume alcohol or not according to their age, sex, and educational attainment. This model analyzes the positive or negative effects of these variables on the dependent variable by evaluating the coefficients of each independent variable. A positive coefficient indicates that the factor in question has an increasing effect on the probability of alcohol consumption, while a negative coefficient indicates a decreasing effect.

$$\begin{aligned} \log \left[\frac{P(\text{SMOKESTATUS} = \text{SMOKER})}{1 - P(\text{SMOKESTATUS} = \text{SMOKER})} \right] = & \alpha + \beta_1(\text{SEX}_{\text{FEMALE}}) \\ & + \beta_2(\text{EDUC}_{\text{PRIMARY}}) + \beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}}) \\ & + \beta_4(\text{EDUC}_{\text{COLLEGE}}) + \beta_5(\text{BASE_10_YEAR}) \end{aligned} \quad (3.2)$$

Logistic Regression Model for Smoking Behavior (Eq 3.2)

The smoking model is the same version of the alcohol consumption model adapted to smoking. Although there are no different variables, all factors that include alcohol are considered smoking in this model. The descriptions of the variables are as follows: α : This is a fixed variable and shows the state of the smoking behavior variable when it is not

3.3. Statistical Analysis Techniques

affected by the other independent variables. $\beta_1(\text{SEX}_{\text{FEMALE}})$: Shows the gender factor and measures the effect of being a woman on smoking behavior, $\beta_2(\text{EDUC}_{\text{PRIMARY}})$, $\beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}})$, $\beta_4(\text{EDUC}_{\text{COLLEGE}})$: These are factors included in educational attainment. They were used to test for differences in smoking behavior according to educational attainment. - $\beta_5(\text{BASE_10_YEAR})$: The purpose of this variable is to group years into 10-year periods. In this formula, which reveals the effect of the time variable on smoking behavior, it is possible to examine how each 10-year time interval affects smoking behavior. In the model shown, the relationship between smoking behavior and the independent variables is calculated and the probability of smoking or not is calculated according to time, gender and educational attainment.

$$\begin{aligned} \log \left[\frac{P(\text{ALCOHOL} = \text{YES})}{1 - P(\text{ALCOHOL} = \text{YES})} \right] = & \alpha + \beta_1(\text{SEX}_{\text{FEMALE}}) + \beta_2(\text{EDUC}_{\text{PRIMARY}}) \\ & + \beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}}) + \beta_4(\text{EDUC}_{\text{COLLEGE}}) + \beta_5(\text{GENERATION}_{\text{SILENT}}) \\ & + \beta_6(\text{GENERATION}_{\text{BOOMER}}) + \beta_7(\text{GENERATION}_{\text{GEN-X}}) \\ & + \beta_8(\text{GENERATION}_{\text{GEN-Y}}) + \beta_9(\text{BASE_10_YEAR}) \end{aligned} \quad (3.3)$$

Logistic Regression Model for Alcohol Consumption Including Generational Effects (Eq 3.3) This model is the generation-added version of the alcohol consumption model. It is precisely the same as the alcohol consumption model; only the generation factor is added. $\beta_5(\text{GENERATION}_{\text{SILENT}})$, $\beta_6(\text{GENERATION}_{\text{BOOMER}})$, $\beta_7(\text{GENERATION}_{\text{GEN-X}})$, $\beta_8(\text{GENERATION}_{\text{GEN-Y}})$: The coefficients included in the model were used to group individuals into generations (Silent, Boomer, Gen X, Gen Y) based on their year of birth and to assess the effect of each generation on the probability of alcohol consumption. This model provides the opportunity to examine from a broader perspective by adding the generation factor to the classical model. Due to this model, we have the opportunity to examine both intergenerational and period changes from a broader perspective. We gain a broader perspective to examine the factors that affect individuals' alcohol consumption.

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$$\begin{aligned}
\log \left[\frac{P(\text{SMOKESTATUS} = \text{SMOKER})}{1 - P(\text{SMOKESTATUS} = \text{SMOKER})} \right] &= \alpha + \beta_1(\text{SEX}_{\text{FEMALE}}) \\
&+ \beta_2(\text{EDUC}_{\text{PRIMARY}}) + \beta_3(\text{EDUC}_{\text{HIGH-SCHOOL}}) + \beta_4(\text{EDUC}_{\text{COLLEGE}}) \\
&+ \beta_5(\text{GENERATION}_{\text{SILENT}}) + \beta_6(\text{GENERATION}_{\text{BOOMER}}) \\
&+ \beta_7(\text{GENERATION}_{\text{GEN-X}}) + \beta_8(\text{GENERATION}_{\text{GEN-Y}}) \\
&+ \beta_9(\text{BASE_10_YEAR})
\end{aligned} \tag{3.4}$$

Logistic Regression Model for Smoking Behavior Including Generational Effects (Eq 3.4)

This model is a version of the smoking model with the added generation factor. From another perspective, it is the version of the Logistic Regression Model for Alcohol Consumption, Including the Generational Effects model, with the Alcohol part replaced by smoking. This model provides the opportunity to examine this from a broader perspective by adding the generation factor to the classical model. Due to this model, we can examine intergenerational and period changes from a broader perspective.

$$p = \frac{e^{\beta_0 + \beta_1 X_1 + \dots + \beta_n X_n}}{1 + e^{\beta_0 + \beta_1 X_1 + \dots + \beta_n X_n}} \tag{3.5}$$

Probability Conversion Formula for Health-Risk Behaviors (Eq. 3.5)

Logistic regression models the probability of an outcome using a linear combination of independent variables. However, this linear combination,

$$z = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n,$$

can theoretically take any value in the range $(-, +)$. To ensure the estimated probability lies within the interval $[0, 1]$, the value of z is passed through the logistic (sigmoid) function:

$$S(z) = \frac{1}{1 + e^{-z}}.$$

Thus, the probability of engaging in a health-risk behavior is obtained using the logistic regression coefficient, as given in Eq. 3.5.

Although the logit transformation,

$$\log \left(\frac{p}{1 - p} \right) = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n,$$

is a linear function of the predictors, the probability itself is not linearly related to the

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independent variables due to the nonlinear nature of the logistic function.

$$\text{Percentage Change} = (\exp(\beta) - 1) \times 100 \quad (3.6)$$

Percentage Change Formula (Eq. 3.6)

To calculate the percentage change associated with a logistic regression coefficient, the following formula is used: Eq. 3.6 provides the percentage change in odds for a one-unit increase in the independent variable.

4. Results

4.1. Descriptive Statistics for Study Variables

In this study, a total of 660,376 data were used. Although 640,571 data were used for smoking, 478,127 data were used for alcohol consumption. 297,876 (45.1%) of the participants were male and 362,500 (54.9%) were female. The distribution of the participants by generations, percentages, and number of people is as follows: Greatest Generation: 28,432 (4.3%), Silent Generation: 119,245 (18.1%), Baby Boomer: 290,726 (44.0%), Gen X: 168,078 (25.5%), Gen Y: 53,895 (8.2%). According to 10-year observations, the number of people in the 1970s and the percentage distribution were 88,679 (%13.84), 31,411 (%4.90) in the 1980s, 167,102 (%26.09) in the 1990s, 183,793 (%28.69) in the 2000s, and 169,586 (%26.47) in the 2010s.

Generation	Number of People	Percentage
Greatest Generation	28,432	4.3%
Silent Generation	119,245	18.1%
Baby Boomer	290,726	44.0%
Gen X	168,078	25.5%
Gen Y	53,895	8.2%

Table 4.1.: Distribution of Participants by Generation

Decade	Number of People	Percentage
1970s	88,679	13.84%
1980s	31,411	4.90%
1990s	167,102	26.09%
2000s	183,793	28.69%
2010s	169,586	26.47%

Table 4.2.: Distribution of Participants by Decade

When participants are distributed by year according to their level of educational

4.1. Descriptive Statistics for Study Variables

Decade	Education Level	Male (%)	Female (%)
1970s	No Education	0.254	0.223
	Primary School	7.96	7.86
	High School	23.0	33.2
	University	15.0	12.5
1980s	No Education	0.105	0.0891
	Primary School	3.08	2.76
	High School	20.7	29.4
	University	21.5	22.4
1990s	No Education	0.122	0.171
	Primary School	2.45	2.87
	High School	18.5	25.1
	University	23.4	27.5
2000s	No Education	0.199	0.242
	Primary School	2.60	2.91
	High School	16.7	19.9
	University	25.3	32.1
2010s	No Education	0.166	0.229
	Primary School	1.94	2.14
	High School	15.7	16.0
	University	28.0	35.8

Table 4.3.: Educational Attainment Distribution by Decade

attainment, in the 1970s, no education was 0.477% in total, 0.254% for men and 0.223% for women. In the primary school section, the participants were 15.82%, 7.96% for males and 7.86% for females. The high school section was 56.2%, 23.0% for males, and 33.2% for females. In the university section, the total participant rate was 27.5%, 15.0% for men and 12.5% for women. The No Education rate for participants in the 1980s was 0.1941%, 0.105% for males, and 0.0891% for females. In the primary school section, the total participant rate is 5.84%, of which 3.08% are male and 2.76% are female. In the high school section, the total participant rate is 50.1%, of which 20.7% are men and 29.4% are female. In the university section, the total participant rate is 43.9%, of which 21.5% are men and 22.4% are women. The No Education rate for participants in the 1990s is 0.293%, of which 0.122% are male and 0.171% are female. In the primary school section, the total participant rate is 5.32%, of which 2.45% are male, and the total participant rate in 87% are female. The total participant rate in the high school section is 43.6%, with 18.5% males and 25.1% females. In the university section, the total participant

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rate is 50.9%, with 23.4% of males and 27.5% of females. The No Education rate for participants in the 2000s was 0.441%, with 0.199% of males and 0.242% of females. The total participant rate in the primary school section was 5. 51%, with 2. 60% men and 2. 91% women. The total participant rate in the high school section was 36.6%, with 16.7% males and 19.9% females. In the university section, the total participant rate is 57. 4%, with males 25. 3% and females 32. 1%. The No Education rate for participants in the 2010s is 0. 396%, with males 0. 166% and females 0. 229%. The total participant rate in the primary school section is 4. 07%, with men 1. 94% and women 2. 14%. The total participant rate in the high school section is 31.7%, with males 15.7% and females 16.0%. In the university section, the total participant rate is 63.8%, with males being 28. 0% and women 35. 8%.

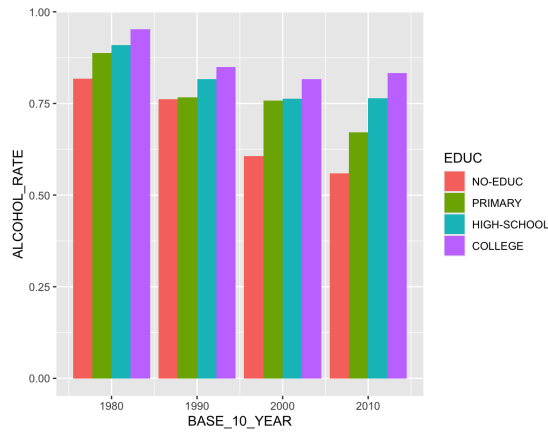


Figure 4.1.: Correlation of Alcohol Consumption and Educational Attainment Change Over Time

This graph (Figure 4.1) shows how alcohol consumption changes according to educational attainment. The time axis shows the alcohol consumption rates that change according to specific years and visualizes them according to educational attainment. Looking at the graph, you can see that the rates of alcohol consumption increase as educational attainment increases. Especially in the COLLEGE category, which represents the university graduate group, the rates of alcohol consumption that increase significantly according to educational attainment are striking. This situation shows that educational attainment has increased alcohol consumption from the 1970s to the present day. Fluctuations began in the graph starting in the 1980s. Especially in the PRIMARY category, which represents primary school graduates, and the NO-EDUC category, which means those who have not completed any education, profound decreases have been observed in alcohol consumption since the

4.1. Descriptive Statistics for Study Variables

1980s. This graph contradicts one of the research hypotheses that health-risk behavior will decrease as educational attainment increases.

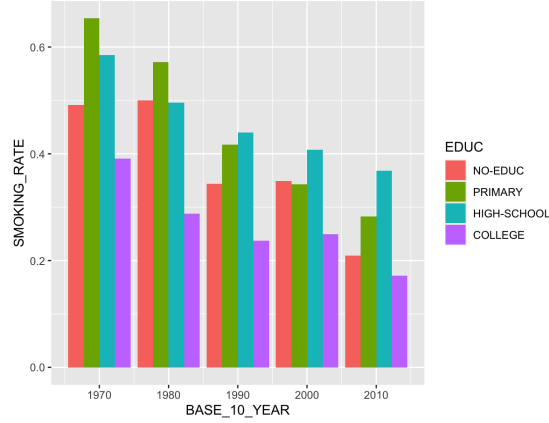


Figure 4.2.: Correlation of Smoking and Educational Attainment Change Over Time

This graph (Figure 4.2) shows how smoking rates change with educational attainment over the years. The graph shows that smoking rates have decreased significantly in every academic category from the 1970s to the present. It shows that the decrease in smoking rates is dramatic, especially in the COLLEGE category, which is among university graduates. This graph supports our hypothesis that health-risk behavior decreases as educational attainment increases. In the 1970s, there were high smoking rates in groups with a low level of educational attainment. Still, in the 1980s, profound decreases were observed, especially in the categories of high school (high school graduates) and PRIMARY (primary school graduates). In the 1990s, profound decreases in smoking rates among university graduates were observed. These decreases in each group show that the public health policies implemented are successful and the awareness levels of the people are increasing.

This graph (Figure 4.3) shows how alcohol consumption rates change over time according to gender and educational attainment. Alcohol consumption rates are observed to increase in both genders with increasing educational attainment. Especially among university graduates, alcohol consumption rates are significantly higher in both genders compared to other categories. However, for women with a low level of educational attainment, it is much lower than for men. Male participants had higher alcohol consumption than female participants at each educational attainment, while female participants were more conservative in their alcohol consumption.

However, as women's educational attainment increases, their alcohol consumption

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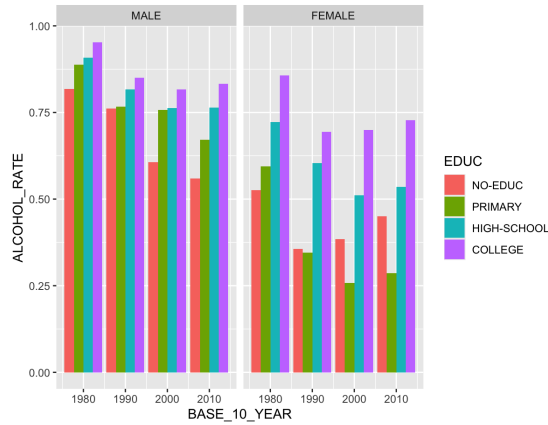


Figure 4.3.: Correlation of Alcohol Consumption and Educational Attainment by Gender - Change Over Time

increases significantly. This situation shows that women with a higher level of educational attainment are more liberal in alcohol consumption. Although men's alcohol consumption has remained stable at high rates since the 1980s, women's consumption has been on an increasing trend since the 1990s.

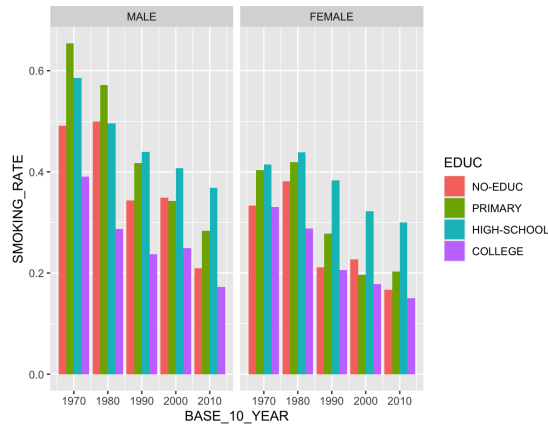


Figure 4.4.: Correlation of Smoking and Educational Attainment by Gender - Change Over Time

This graph (Figure 4.4) shows how alcohol consumption rates change over time according to gender and educational attainment. With increased educational attainment, there have been significant changes in smoking rates in both sexes. Smoking is particularly low among university graduates. This situation shows that people with high educational attainment have high health awareness in both genders and that people are more inclined

4.1. Descriptive Statistics for Study Variables

to limit their smoking behavior as health awareness increases with educational attainment in both genders. Smoking is high in men at all levels of educational attainment. Although smoking was exceptionally high in men without education in the 1970s, this rate has decreased as we approach the present day.

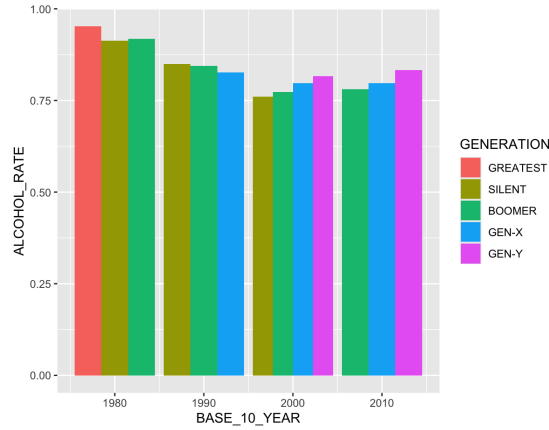


Figure 4.5.: Alcohol Consumption Rates by Generation - Change Over Time

However, although smoking has increased in women since the 1980s, it has always been lower than in men. These results show that women have always had a more conservative attitude towards smoking than men and that women are more influenced by culture. Although men's smoking rate has decreased over time since the 1970s, an increasing trend has been observed in women since the 1980s. This also reveals the effect of the transformation of gender roles toward women. In general, smoking has decreased significantly in both sexes since the 2000s. This is a sign of the success of public and health policies and the increase in health awareness.

This graph (Figure 4.5) shows changes in alcohol consumption rates in different generations (Greatest, Silent, Boomer, Gen X, Gen Y) over time. According to general observations, alcohol consumption rates are high in every generation; the rates usually exceed 0.7. Although the Greatest Generation showed the highest alcohol consumption rate until the 1980s, this situation was followed by the Silent Generation and then the Boomer Generation over the years. Although there are no significant differences between generations, some increasing and decreasing trends are observed. When we examine the generations in order, the Greatest Generation had the highest rate in the 1980s but decreased to similar rates as the other generations as they got older. The Silent Generation's alcohol consumption has remained almost constant since the 1980s, and no significant differences have been observed. The Boomer generation's alcohol consumption

4. Results

rates have also progressed similarly to the Silent generation. When it comes to Gen X, and Gen Y's alcohol consumption rates have progressed similarly to previous generations in 2000 and 2010, but Gen Y has the highest alcohol consumption rates as of the 2010s. Generally, generations have high alcohol consumption during their youth, but this rate decreases as they age.

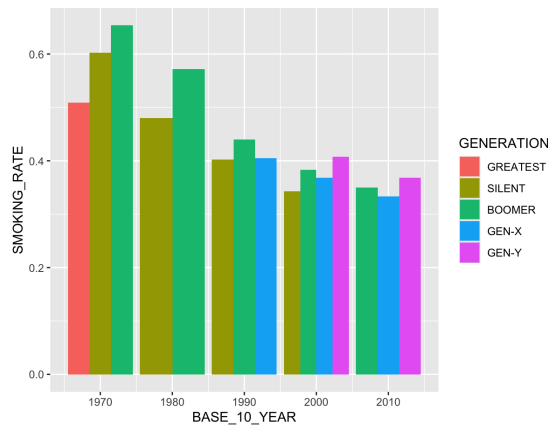


Figure 4.6.: Smoking Rates by Generation - Change Over Time

This graph (Figure 4.6) shows changes in smoking rates in different generations (Greatest, Silent, Boomer, Gen X, Gen Y) over time. According to the table, smoking rates were very high in the 1970s but reached much higher rates, especially for the boomer generation. On the other hand, when we look at the graph as a whole, we see severe decreases in smoking as we approach the present day. This situation shows that anti-smoking campaigns are successful, and the public is becoming more aware of health. From a generational perspective, the Greatest Generation had the lowest smoking rate in the 1970s but decreased over time. As they grew older, smoking rates decreased and they switched to a healthier lifestyle. Although smoking rates started at a high level in the Silent generation, they tended to decline over time, and this trend showed a stable trend. The boomer generation had the highest smoking rates in the 1970s and 1980s, but starting in the 1990s, smoking rates began to decline and they began to show a tendency to stay away from smoking. Gen X started with a relatively low smoking rate and showed a decreasing trend. Gen Y began at a slightly higher rate than Gen X, but continued to show a decreasing trend. After the 1970s, smoking rates began to decrease noticeably with each generation and continued in this manner. This shows us that successful public health policies are being implemented and that the younger generation is adopting a healthier lifestyle.

4.2. Multivariate Analysis of Educational Attainment and Health-Risk Behaviors

According to the data of this study, the distribution of educational attainment and gender over the years has shown remarkable changes. According to the data, the no-education rate was relatively low for both genders in the 1970s, indicating that access to education was quite common during these periods, but going above the basic level of educational attainment was not very common. Although there was a minimal gender difference among those who graduated from primary school, gender differences began to be seen in those who went beyond primary education. Although women were at the forefront in the number of high school graduates, the rate of men was seen to be higher when looking at university graduates. However, significant changes were observed in the ten years of the 1980s. The rates of women who participated were high school and university graduates higher than those of men. In the 1990s, 2000s, and 2010s, the educational attainment of women participants continued to rise. Although women's university education was behind men in the 1970s, women closed this gap and surpassed men in the following years. When focusing on the research data, it appears that the gender ratio of the participants is balanced and there is a homogeneous distribution.

However, the level of educational attainment in society has increased significantly over the years. The fact that university graduates have a more significant place in social life is among the main reasons for this trend. In the context of gender equality that became widespread in the 1990s, women's educational attainment levels have increased. On the other hand, not only women but also both genders have increased in educational attainment, and this is considered as the success of education policies.

4.2. Multivariate Analysis of Educational Attainment and Health-Risk Behaviors

Educational attainment has a very high effect on smoking behavior (Table 4.6). Women are significantly less likely to smoke than men (log-odds = -0.305, $p < 0.01$), meaning that females are 26.1% less likely to smoke than males.

Smoking rates also vary by educational attainment. Individuals with primary education are significantly more likely to smoking behavior than those with no education (log-odds = 0.574, $p < 0.01$, +77.7%). The likelihood increases further among high school graduates (log-odds = 0.850, $p < 0.01$, +132.5%). However, among college graduates, the smoking rate does not increase significantly (log-odds = 0.066, $p = \text{n.s.}$, +6.8%), indicating that higher education levels are associated with lower smoking rates.

Generational differences in smoking behavior are also observed. The Silent Generation

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Table 4.4.: Logistic Regression Results for the Relationship Between Smoking and Educational Attainment

	<i>Dependent variable:</i>
	SMOKESTATUS
SEXFEMALE	−0.304*** (0.006)
EDUCPRIMARY	0.559*** (0.053)
EDUCHIGH-SCHOOL	0.865*** (0.052)
EDUCCOLLEGE	0.088* (0.052)
BASE_10_YEAR	−0.021*** (0.0002)
Constant	39.833*** (0.438)
Observations	640,571
Log Likelihood	−361,215.700
Akaike Inf. Crit.	722,443.500
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

Table 4.5.: Logistic Regression Results for the Relationship Between Smoking and Educational Attainment (Including Generations)

	<i>Dependent variable:</i>
	SMOKESTATUS
SEXFEMALE	−0.305*** (0.006)
EDUCPRIMARY	0.574*** (0.053)
EDUCHIGH-SCHOOL	0.850*** (0.052)
EDUCCOLLEGE	0.066 (0.052)
GENERATIONSILENT	0.196*** (0.014)
GENERATIONBOOMER	0.299*** (0.016)
GENERATIONGEN-X	0.209*** (0.017)
GENERATIONGEN-Y	0.311*** (0.021)
BASE_10_YEAR	−0.023*** (0.0003)
Constant	44.764*** (0.648)
Observations	640,571
Log Likelihood	−360,958.800
Akaike Inf. Crit.	721,937.600
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

4.2. Multivariate Analysis of Educational Attainment and Health-Risk Behaviors

Table 4.6.: Logistic Regression Results for the Relationship Between Smoking and Educational Attainment (Including Generations) with Log-Odds, Percentage Changes, and Probabilities

	<i>Log-Odds</i>	<i>SE</i>	<i>Percentage Change</i>	<i>Probability</i>
	β	(Std. Error)	$(e^\beta - 1) \times 100$	$\frac{e^\beta}{1+e^\beta}$
Sex (Ref: Male)				
Female	-0.305***	(0.006)	-26.1%	42.4%
Education (Ref: No Education)				
Primary	0.574***	(0.053)	+77.7%	63.9%
High School	0.850***	(0.052)	+132.5%	70.1%
College	0.066	(0.052)	+6.8%	51.6%
Generation (Ref: Greatest Generation)				
Silent	0.196***	(0.014)	+21.6%	54.9%
Boomer	0.299***	(0.016)	+34.8%	57.4%
Gen X	0.209***	(0.017)	+23.3%	55.2%
Gen Y	0.311***	(0.021)	+36.5%	57.7%
BASE_10_YEAR	-0.023***	(0.0003)	-2.3%	49.4%
Constant	44.764***	(0.648)	-	-
Observations			640,571	
Log Likelihood			-360,958.800	
Akaike Inf. Crit.			721,937.600	

Note:

*p<0.1; **p<0.05; ***p<0.01

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has a higher likelihood of smoking than the Greatest Generation (log-odds = 0.196, $p < 0.01$, +21.6%). The Baby Boomer generation exhibits an even greater increase (log-odds = 0.299, $p < 0.01$, +34.8%). Generation X follows a similar pattern, with an increased likelihood of smoking compared to the Greatest Generation (log-odds = 0.209, $p < 0.01$, +23.3%). Generation Y shows the highest increase in smoking behavior among all generations analyzed (log-odds = 0.311, $p < 0.01$, +36.5%).

Table 4.7.: Logistic Regression Results for the Relationship Between Alcohol Consumption and Educational Attainment

	<i>Dependent variable:</i>
	ALCOHOL
SEXFEMALE	−0.958*** (0.007)
EDUCPRIMARY	0.426*** (0.051)
EDUCHIGH-SCHOOL	1.097*** (0.050)
EDUCCOLLEGE	1.593*** (0.050)
BASE_10_YEAR	−0.018*** (0.0004)
Constant	36.148*** (0.718)
Observations	478,127
Log Likelihood	−282,607.400
Akaike Inf. Crit.	565,226.900
<i>Note:</i>	* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

A time trend analysis reveals that smoking rates have been steadily decreasing over the years (log-odds = -0.023, $p < 0.01$, -2.3% per decade). This decline suggests that public health policies targeting smoking cessation have been effective over time.

The model used 640,571 observations. The log-likelihood value, which indicates the model's fit to the data, is -360,958.800.

According to the research results, smoking behavior seems to be related to the analyzed independent variables, namely educational attainment, generations, gender and time intervals. Men have higher smoking behavior probabilities than women. Smoking behavior, which increases in each educational attainment category until university graduation, decreases after university graduation and the highest rate belongs to high school graduates. While smoking behavior gradually decreases among generations, it increased in Generation Y and reached its peak in Baby Boomers and Generation Y. On the other hand, the decrease in smoking behavior over time is associated with successfully implemented public health policies.

4.2. Multivariate Analysis of Educational Attainment and Health-Risk Behaviors

Educational attainment has a very high effect on alcohol consumption (Table 4.9). Although the alcohol consumption rate of people with primary education is high (log-odds = 0.434, $p < 0.01$, +54.5%), this rate increases among high school graduates (log-odds = 1.099, $p < 0.01$, +200.4%) and reaches its highest point among university graduates (log-odds = 1.590, $p < 0.01$, +391.4%). Different behavioral patterns were observed in the two different health-risk behaviors examined. Increasing educational attainment increased alcohol consumption and decreased smoking behavior. This shows that there is a positive correlation between educational attainment and alcohol consumption, while there is a negative correlation between educational attainment and smoking behavior.

As a result, the alcohol consumption rate of women was 61.7%, indicating that women had significantly lower alcohol consumption rates than men (log-odds = -0.961, $p < 0.01$). As educational attainment increased, alcohol consumption also increased, but there was a small decrease in alcohol consumption over time (log-odds = -0.022, $p < 0.01$, -2.2%).

The model used 478,127 observations. The log-likelihood value, which indicates how well the model fits the data, is -281,993.000. The Akaike Information Criterion (AIC) value is 564,006.100, providing a basis for comparing the model's fit to other models.

Table 4.8.: Logistic Regression Results for the Relationship Between Alcohol Consumption and Educational Attainment (Including Generations)

	<i>Dependent variable:</i>
	ALCOHOL
SEXFEMALE	-0.961*** (0.007)
EDUCPRIMARY	0.434*** (0.051)
EDUCHIGH-SCHOOL	1.099*** (0.050)
EDUCCOLLEGE	1.590*** (0.050)
GENERATIONSILENT	-0.389*** (0.114)
GENERATIONBOOMER	-0.421*** (0.113)
GENERATIONGEN-X	-0.386*** (0.114)
GENERATIONGEN-Y	-0.027 (0.114)
BASE_10_YEAR	-0.022*** (0.0004)
Constant	45.078*** (0.851)
Observations	478,127
Log Likelihood	-281,993.000
Akaike Inf. Crit.	564,006.100

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

When examined between generations, differences in alcohol consumption are observed

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Table 4.9.: Logistic Regression Results for the Relationship Between Alcohol Consumption and Educational Attainment (Including Generations) with Log-Odds, Percentage Changes, and Probabilities

	<i>Log-Odds</i>	<i>SE</i>	<i>Percentage Change</i>	<i>Probability</i>
	β	(Std. Error)	$(e^\beta - 1) \times 100$	$\frac{e^\beta}{1+e^\beta}$
Sex (Ref: Male)				
Female	-0.961***	(0.007)	-61.7%	27.7%
Education (Ref: No Education)				
Primary	0.434***	(0.051)	+54.5%	60.7%
High School	1.099***	(0.050)	+200.4%	75.0%
College	1.590***	(0.050)	+391.4%	83.0%
Generation (Ref: Greatest Generation)				
Silent	-0.389***	(0.114)	-32.2%	40.4%
Boomer	-0.421***	(0.113)	-34.3%	39.6%
Gen X	-0.386***	(0.114)	-31.9%	40.5%
Gen Y	-0.027	(0.114)	-2.7%	49.3%
BASE_10_YEAR	-0.022***	(0.0004)	-2.2%	49.4%
Constant	45.078***	(0.851)	-	-
Observations			478,127	
Log Likelihood			-281,993.000	
Akaike Inf. Crit.			564,006.100	

Note:

*p<0.1; **p<0.05; ***p<0.01

4.3. Discussion of Significant Findings and Their Implications

(Table 4.9). The Silent Generation and Baby Boomers have significantly lower alcohol consumption rates than the Greatest Generation (log-odds = -0.389, -32.2% and -0.421, -34.3%, respectively, $p < 0.01$). Generation X also shows a decreasing trend in alcohol consumption (log-odds = -0.386, -31.9%, $p < 0.01$). However, no statistically significant reduction was observed for Generation Y (log-odds = -0.027, -2.7%, $p = \text{n.s.}$). The analysis of alcohol consumption trends over time shows a significant decline (log-odds = -0.022, -2.2%, $p < 0.01$), which aligns with findings in smoking behavior. One of the factors that show that public health policies reduce health-risk behavior is the decrease in alcohol consumption rates over the years.

In summary, the Silent Generation, Baby Boomers, and Generation X show significant reductions in alcohol consumption compared to the Greatest Generation, while no significant change was detected for Generation Y.

As a result, health-risk behaviors are correlated with gender, educational attainment, generation, and years, as confirmed by these multivariate analyses. While women engage less in health-risk behaviors than men, individuals with higher educational attainment are more likely to consume alcohol but less likely to smoke. The research highlights substantial generational differences: younger generations exhibit lower smoking and alcohol consumption behaviors. This shows that public health initiatives are successful, new generations have more and more awareness and are turning to healthier lifestyles.

4.3. Discussion of Significant Findings and Their Implications

Educational attainment has a very high effect on smoking and alcohol consumption behavior (Table 4.6). Women are significantly less likely to smoke than men (log-odds = -0.305, $p < 0.01$), meaning that females are 26.1% less likely to smoke than males. This can be attributed to gender roles and social pressures, as well as cultural factors and higher health awareness among women. These findings suggest that public health policies should primarily target men and focus on strategies to reduce their smoking rates.

Smoking rates also vary by educational attainment. Individuals with primary education are 77.7% more likely to smoke than those with no education (log-odds = 0.574, $p < 0.01$). High school graduates exhibit an even greater likelihood of smoking (log-odds = 0.850, $p < 0.01$, +132.5%). The increase in smoking behavior among college graduates was not statistically significant or significant (log-odds = 0.066, $p = \text{n.s.}$, +6.8%). This suggests that college education does not contribute significantly to smoking behavior.

Generational differences in smoking behavior are also observed. The Silent Generation has a 21.6% higher likelihood of smoking compared to the Greatest Generation (log-odds

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= 0.196, $p < 0.01$). The Baby Boomer generation exhibits an even greater increase (log-odds = 0.299, $p < 0.01$, +34.8%). Generation X follows a similar pattern, with an increased likelihood of smoking (log-odds = 0.209, $p < 0.01$, +23.3%). Generation Y shows the highest increase in smoking behavior among all generations analyzed (log-odds = 0.311, $p < 0.01$, +36.5%).

Examining smoking across generations is essential to understanding historical trends in health-risk behaviors. When past generations are examined, there are much higher rates of smoking behavior compared to today's generations, this may be due to smoking behavior being a much more accepted social norm in those years. On the other hand, the increased smoking behavior seen in Generation Y may have occurred due to factors such as media, cultural norms, peer influence, and stress. These generational differences indicate that public health policies must be tailored to different age groups to address unique cultural and behavioral patterns.

A time trend analysis reveals that smoking rates have been steadily decreasing over the years (log-odds = -0.023, $p < 0.01$, -2.3% per decade). The decline in smoking behavior shows us that anti-smoking campaigns, public health policies and laws are effective. On the other hand, the decrease in smoking behavior over time and the differences between generations emphasize the importance of examining it from a generational perspective.

Another health-risk behavior, alcohol consumption, also has a strong relationship with educational attainment. Individuals with primary school education have an increased likelihood of consuming alcohol (log-odds = 0.434, $p < 0.01$, +54.5%). This effect strengthens among high school graduates (log-odds = 1.099, $p < 0.01$, +200.4%). The highest rate of alcohol consumption is among college graduates. This result shows us that college graduates are highly correlated with alcohol consumption (log-odds = 1.590, $p < 0.01$, +391.4%). The low standard errors in these estimations suggest high reliability in the model's predictions.

When analyzing generational trends in alcohol consumption, the Silent Generation is significantly less likely to consume alcohol than the Greatest Generation (log-odds = -0.389, $p < 0.01$, -32.2%). Baby Boomers show an even lower likelihood (log-odds = -0.421, $p < 0.01$, -34.3%), followed by Generation X (log-odds = -0.386, $p < 0.01$, -31.9%). However, Generation Y shows the smallest decline in alcohol consumption likelihood (log-odds = -0.027, $p = \text{n.s.}$, -2.7%), indicating that alcohol consumption behaviors have shifted across generations, potentially due to cultural and social influences.

A time trend analysis for alcohol consumption reveals a steady decline over the years (log-odds = -0.022, $p < 0.01$, -2.2% per decade). The very high Z-value (-52.606) and low standard error (0.0004) indicate that this result is statistically significant and highly

4.3. Discussion of Significant Findings and Their Implications

reliable. This decline suggests that public health campaigns and policy interventions aimed at reducing alcohol consumption have been effective over time.

The model used 640,571 observations. The log-likelihood value, which indicates the model's fit to the data, is -360,958.800. The AIC value is 721,937.600, providing a basis for comparing model performance against other statistical models.

Finally, the health-risk behaviors examined in our study, smoking behavior and alcohol consumption, were significantly associated with the variables examined: time trends, generations, gender, and educational attainment. Women are less likely to smoke than men, and smoking rates tend to decrease as educational attainment increases, although high school graduates have the highest prevalence. Alcohol consumption is also directly related to educational attainment, but as educational attainment increases, alcohol consumption rates increase. When examined generationally, it is seen that the health-risk behaviors discussed in the study have evolved over time, with smoking behavior reaching its peak with the Baby Boomers and Generation Y, while alcohol consumption has shown a generational decline. The steady reduction in both behaviors over time suggests that public health initiatives have successfully mitigated associated health-risks behaviors in recent years.

5. Discussion

5.1. Interpretation of Results Considering Previous Research and Theoretical Frameworks

Past research has shown that socio-economic conditions and family are the factors that most influence health-risk behavior, especially during adolescence. Bourdieu's (1984) theories of socialization and habitus have been particularly influential in explaining the causes of this issue. Habitus is the generative scheme in which social structures are embodied within perception schemes, providing the individual with a predetermined way of thinking, feeling, and acting [Bourdieu, 1984]. socio-economic conditions determine the habitus of individuals, and habitus determines their behavior. Individuals whose parents engage in health-risk behaviors during socialization are likelier to engage in similar behaviors while socializing during adolescence and adulthood [Singh-Manoux et al., 2005]. Bourdieu has studied how people accept or resist the norms and values of the environment in which they are born [Thirlway, 2019]. Low socio-economic status and stigmatization as poor create tension between a complete rejection of dignity and respectability of individuals [Sayer, 2002]. Living in poverty leads to dual labeling of health risk behaviors [Thompson et al., 2007]. This may lead to extra avoidance behavior in some people to prevent health risk behaviors such as tobacco use disorder, drug use disorder, unprotected sex, and binge drinking because they want to avoid being labeled in a class stigma [Graham, 2012]. Their efforts to form an identity differently led to avoiding health risk behavior and developing a positive self-image concerning morality and health [Bolam et al., 2004]. Although individuals resist their class identity, they are aware of their class regarding material and social resources [Bolam et al., 2004]. These resources include a university education and financial security to compensate for a health problem resulting from any health risk behavior. When we evaluated the results of this research within the scope of previous research, similar results were reached [Tinner et al., 2021]. More educated people generally tend to be healthier and avoid health-risk behavior. Research that says educational attainment positively affects health behaviors so far typically bases this on productivity. More educated people have a better ability to process information.

5.1. Interpretation of Results Considering Previous Research and Theoretical Frameworks

People with better information processing capacity are less likely to engage in unhealthy behaviors. This is because these individuals are more aware of the risks and dangers of harmful behaviors. However, this is not only the case in excessive alcohol consumption behavior [Cowell, 2006].

On the other hand, Americans have poor health compared to individuals in other high-income countries [Woolf and Aron, 2013]. This is because there are very high health inequalities between social classes in the United States, and low-educated adults have high health problems [Marmot and Bell, 2009]. Education is crucial to learning the benefits of avoiding health risk behaviors, improving public well-being, and reducing health inequalities.

Researchers have generally focused on three main hypotheses to examine the relationship between education and health. The first is the fundamental cause theory, the leading theory researchers have focused on in the last 20 years [Link and Phelan, 1995]. Fundamental Cause Theory states that education and social environment are the main determinants of health and disease. According to this theory, education and social environment determine people's access to many material and spiritual resources, such as their income status, residing in safer neighborhoods in the neighborhoods they live in, and preferring a healthier lifestyle and diet. These factors make individuals maintain and improve their health [Freese et al., 2011]. Secondly, Human Capital Theory, which is used mainly in econometrics, says that education is the concept that provides returns by increasing productivity [Becker, 1964]. The rise in educational attainment allows individuals to improve many factors such as skills, abilities, increased knowledge, and evaluation abilities, enhancing their skills and increasing their health status [Mirowsky, 2003]. The third approach is a theory called the Signaling or Credentialing perspective [Collins, 2019, Spence, 1973]. According to this theory, markers such as high school diplomas and university diplomas give several signals about individuals' abilities and skills. According to this theory, specific points in education, such as 12-year and 16-year periods, that is, high school and university diplomas, lead to significant improvements in health. However, situations such as graduating from university give us clues about the individual's knowledge and many concepts, such as the individual's intelligence, abilities, problem-solving ability, and potential in business life.

These three theories explain the relationship between education and health from a causal perspective and identify many factors in which educational attainment affects health. Human Capital Theory identifies health-influencing factors as concrete skills and abilities through education, fundamental cause theory focuses on the change and flexibility of factors, and Signaling or Credentialing identifies social responses to educational attainment. However, these three theories evaluate educational attainment in terms of success and do

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not focus on how factors such as quality and type of educational attainment affect health. These theories focus on individual factors, excluding individual achievement, how success affects people and the social environment in which education and health processes are located. Many experimental studies show that increased educational attainment positively correlates with a healthy life. However, there are significant differences within the groups [Hill and Needham, 2006, Holmes and Zajacova, 2014, McDonough et al., 1999]. Education has powerful health effects on women compared to men. On the other hand, the same situation exists for non-Hispanics in the United States; that is, the impact of education on health is more substantial for non-Hispanics [Williams and Collins, 1995, Williams and Jackson, 2005]. In the study conducted by Western University in 2018, the data of participants aged 25 to 64 years from the National Health Interview Survey (NHIS) between 2002 and 2016 were taken and examined. As a result of this research, three noteworthy observations were made. According to the results, while 57% of men and women who are not high school graduates describe their health status as bad, this rate decreases to 9% among university graduates.

The second observation is that there are significant differences between the groups in the predicted levels of health and the effects of educational attainment on this situation. Although the results are unclear, educational attainment is much more effective in women's health levels. Another result is that educational attainment has a much more significant impact on health in whites. The third item is interesting. This is about adults who have had some college education but have yet to complete college. The health status of adults at this level of educational attainment is similar to that of high school graduates. However, adults with this condition have invested and benefited from college education [Zajacova and Lawrence, 2018].

Four main mechanisms may explain the healthier behaviors of more educated adults. These are economic, social, psychological, access to health services, and health behavioral. Adults with higher educational attainment have more stable and high-paying jobs and thus have the financial savings to improve their health status [Mirowsky, 2003]. Economic conditions are thought to account for 30% of the correlation between health and educational attainment [Schoeni et al., 2008]. Health-risk behavior is an essential factor in health, but this alone does not explain the effects of educational attainment on health. However, higher-educated adults have been shown to smoke less, exercise more, and follow a healthier diet [Cutler and Lleras-Muney, 2009, Lawrence, 2017, Pampel et al., 2010, Schoenborn et al., 2013]. From a social and psychological point of view, increased educational attainment leads to longer and more successful marriages, which provides tremendous support in dealing with stress factors and daily problems [Taylor and Seeman, 1999, Waite

5.2. Implications for Public Health Policy and Education Initiatives

and Gallagher, 2002]. On the other hand, access to health services has the most substantial role of all factors, but it is the least influential factor [Hoffmann, 2008, Ross and Wu, 1995, Williams, 1990]. In addition to these four most influential factors, researchers have shown that many factors, such as stress, cognitive factors, non-cognitive personal skills, and environmental situations, also play an essential role in the relationship between health and educational attainment [Baum et al., 1999, Evans and Kantrowitz, 2002]. Many empirical studies have been conducted on how education and health affect each other, and natural and twin experiments have been performed. These analyses are necessary because public policies on education and health both increase public welfare and reduce high healthcare expenditures. In general, research has focused on the correlation of educational attainment with health behaviors. What is meant by natural experiments is the examination of the effect of this situation on health when the education rate is increased in a population group, that is, when the compulsory education year is increased. In 2005, a study was conducted in the United States examining the effect of mandatory education reforms on mortality rates between 1915 and 1939. According to the results, a one-year increase in educational attainment reduced mortality rates by 3.6% [Lleras-Muney, 2005]. When data were reanalyzed and state data were taken into account, it showed that it had little effect on mortality rates, but it had an impact on general health [Mazumder, 2008].

On the other hand, another study of older Americans found that educational attainment affected health status but not mortality [Fletcher, 2015]. In some twin experimental studies conducted in the United States, high causality was found between educational attainment and health [Lleras-Muney, 2005]. However, some studies obtained modest results on the correlation between educational attainment and health [Fujiwara and Kawachi, 2009]. Twin experiments are used in these studies to minimize the effect of biological and familial factors. However, research has generally focused on high-income countries, leaving many question marks that need to be answered [Zajacova and Lawrence, 2018].

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The findings we obtained in the research are important in terms of creating a public health policy and determining the arrangements that can be made in the field of education within this policy. Smoking decreases as the level of educational attainment increases in

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both genders; on the other hand, when examined temporarily, it was found that smoking gradually decreased at every level of educational attainment. When alcohol consumption was analyzed, more complex patterns were reached. As educational attainment increased, it was observed that alcohol consumption increased in both men and women. Research on variation over time can explain how policy changes affect the correlation between health-risk behavior and educational attainment. Future research should utilize data sets that take into account the amount and frequency of alcohol consumption when determining the relationship between alcohol consumption and educational attainment. Deeper insights can be obtained by determining the difference between moderate and low levels of alcohol consumption and high levels of alcohol consumption and examining the relationship between educational attainment. However, future studies should consider the principle of reverse causality in addition to cultural and religious factors.

In recent years, the health inequalities caused by education have increased compared to previous years [Goesling, 2007] [Liu and Hummer, 2008] [Masters et al., 2012] [Sasson, 2016] [Zajacova and Montez, 2017]. The basis of the increase in education-related health inequalities is neoliberal policies that have increased since the 1980s [Coburn, 2000]. Since the 1980s, the United States has been plagued by increasing social inequality, in which the middle class has steadily declined while wealthy Americans have increased their wealth [Bor et al., 2017] [Monnat, 2016] [Temin, 2017]. Education-related health inequalities, which have increased in recent years, were lower in the 1960s and 1970s [Johnson et al., 2016]. This is because, in the 1960s and 1970s, public policies were often aimed at reducing social inequality. These policies were aimed at eliminating racial discrimination, increasing equality between men and women, the civil code, and increasing the welfare of low-income people [Navarro and Shi, 2001]. This shows that inequality is not the only inevitable consequence of rising over time; the non-neoliberal policies of the 1960s and 1970s show that this inequality can decrease at will.

Another point is that the correlation between educational attainment and health behaviors is directly related to social policies. There are many reasons why increasing inequalities are very clear in research. Groups with low levels of educational attainment also decrease their representation in society over time. The reason for this is that social groups with a low level of educational attainment have a lower composition in society over time and through adverse selection. As the level of educational attainment of the population increases, groups with low levels of educational attainment decrease, and often, the well-being of people with low educational attainment decreases even more. However, the impact of these inequalities on the majority of society is small and limited because they affect a minor group [Dowd and Hamoudi, 2014, Hendi, 2015]. Examining

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the correlation between education and health behaviors in larger frameworks helps to understand how education-induced health inequalities between individuals emerge and increase and to understand that these situations develop not only at the individual level but also at the social level. Education and health are at the heart of improving the well-being of the individual and society. They are critical for the health of the individual and society. At the same time, they are the primary factors that make up happy, healthy societies and individuals. These situations include not only individuals but also social structures and contexts because it is not only through individual effort that an individual can be healthy and receive a good education. The economic situation of society is directly related to social policies and environmental factors.

The best suggestion for future research is to look at individual behavior from a broader perspective rather than focusing on it. To produce successful policies, successful holistic determinations must be made, and this can only be achieved through interdisciplinary cooperation. The most basic requirement for these is powerful and rich data sources. However, there is still an opportunity for research and policy development for the American people, who are experiencing increasing inequalities and regression in terms of social and health well-being. With the right policies, public health can be improved, educational attainment can increase, and social welfare can be increased. In particular, we can look at the non-neoliberal social policies of the 1960s and 1970s and see that this has been done before [Zajacova and Lawrence, 2018].

According to this research, changes can be made in education to improve public health policies. There is a correlation between educational attainment and health-risk behavior; especially in individuals with a low level of educational attainment, smoking behavior is much higher.

For the education level to bring healthy lifestyles to individuals, it may be beneficial to add curricula to the results of healthy life education and health-risk behaviors, especially in high school curricula. On the other hand, health-risk behaviors are seen at all other levels of education. Therefore, awareness-raising coverage should be organized in society. Men have a stronger orientation towards such behaviors than women. Different strategies for women and men should be developed, and the focus should be primarily on strategies for men in a more strict way. Another point is educational attainment. Educational attainment is a social security. Therefore, public health can be improved with policies to eliminate social inequality, and the measures that can be taken in this regard can be detailed. It is possible to improve public health with reforms in education. Supports such as increasing policies to make people with low educational attainment quit smoking and free health screening can help improve public health. Research shows that extending

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the education period by one year increases a person's lifetime earnings by 10%. In other words, if the total gain of the person's lifetime is 800,000 dollars, it increases by 80,000. Studies have shown that one year of more education increases life expectancy by 0.18 years, approximately two months. The research determined that the monetary value of one more year of life is approximately 75,000 dollars. Increasing life expectancy by studying for one year by 0.18 years gives you an average health return of \$13,500 ($0.18 \text{ years} \times \$75,000$). These results show that the health returns obtained through education can increase the educational returns by 15% to 55%. According to these findings, education has an essential effect on the relationship between education and health.

However, states only need to allocate a budget to this and provide the required subsidies if individuals cannot invest in education at an optimal level. This means that informed policies must show that the educational investments they will make in themselves will be not only monetary but also in terms of health. The subsidy requirements of states for education are that individuals need to be made aware of the health returns of education and have the financial means to meet it. By increasing individual awareness through campaigns, the burden of education subsidies can be reduced, and the level of educational attainment can be increased [Cutler and Lleras-Muney, 2008]. However, the United States of America developed and implemented many policies to reduce health-risk behavior.

Regarding smoking, the sale of tobacco under the age of 21, sales in vending machines, the sale of packages containing less than 20 cigarettes, sponsorship of sports and entertainment events with tobacco brands, free cigarettes, and the sale of cigarette products are prohibited [U.S. Preventive Services Task Force, 2013]. The National Minimum Legal Drinking Age Act of 1984 is an excellent example of an alcohol policy. Alcohol consumption increased the age to 21, with fewer traffic accident deaths in the country associated with murder, suicide, and unintentional injury [McCartt et al., 2010].

5.3. Limitations of the Study and Suggestions for Future Research

This research found significant results by examining the correlation between health-risk behavior and educational attainment. However, as in every scientific study, there are some limitations in this scientific study. The data set used in this study covers an extended period. There have been significant changes over such a long period. One of them is the time zone and the changing educational system. With the high-school education system in the 1960s, there have been considerable changes in high-school education acquired

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in the 2000s, and they are very different in terms of quality and curriculum. This can lead to many things that could be improved. However, a high school graduate's social class and status in the 1970s is very different from that of the 2010s. If differences in social status caused by the level of educational attainment over the years are included in future research, more meaningful results can be obtained. For this, the proportion of all university, high school, and primary school graduates in the population can be included in future research. The variables HIGRADE2 and EDUC used in the study were measured differently in different years and combined, which may have created data incompatibilities in some cases. Especially in the old years, while data categorization was done with more general categories, it has become more and more specific. Using more specific analysis methods in future research can eliminate the problems experienced here. When collecting data on health-risk behavior, such as alcohol and smoking, people usually report their usage rates by themselves. Since the data in the study was collected at the participants' own discretion, situations such as incomplete or incorrect reporting by the participants may occur. In matters such as alcohol consumption and smoking, participants may claim to consume too much or to stay away entirely depending on their emotional state, social norms, and the environment they live in, and this may affect the reliability of the research results. If future research can be performed based on the biological measurements and health records of the individuals, more objective results can be obtained, and data bias can be reduced. For example, individuals' actual health-risk behaviors can be analyzed by making nicotine measurements. This study only focused on the relationship between educational attainment and health-risk behavior. Factors such as the cultural and socio-economic status, environment, religion, family structure and social norms of the participants were not taken into account. On the other hand, these factors are the factors that directly affect the correlation between educational attainment and health-risk behavior and socio-economic status is also a primary determinant. However, this research focuses only on educational attainment. Smoking behavior is much more common, especially in low socio-economic groups. At the same time, alcohol consumption is more common at a high-income level. All of these factors have been ignored in this research.

In future studies, more solid results can be obtained by examining socio-economic conditions, different cultures, and income ranges, and more specific health policies can be developed thanks to studies examining different subgroups. Another group that can enrich the research is the age factor. For example, young people are more prone to alcohol and smoking, while older people may avoid this behavior. Independent of their education status, people tend to avoid health-risk behavior in future years. In a more

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developed study, different effects of the level of educational attainment on age groups can be considered. This research may contribute to the development of generational health policies. According to the research results, it was determined that there was a correlation between the two variables, but it was not fully determined whether there was a causality between the variables examined. Individuals make more conscious choices in higher education, but it has not been decided whether these preferences are due to increased education or other factors. Genetic factors, childhood environment, and social experiences also affect health-risk behavior, but these factors have not been examined in our research. More experimental or semi-experimental studies should be designed to better understand these relationships in the future. Another limitation is the age and time intervals. Since this research covers the age range of 25-60 and between 1970-2018, the behaviors of Generation Z and the education health correlations of the 2020s were not examined. The youngest processable birth year data belong to 1993. Since those born in 1995 and later are considered Generation Z, no data on Generation Z have been examined. This is because there are not yet enough data for the 2020s when we look at the 10-year periods and examine the age of 25 and over [McCrindle, 2022].

An important limitation of the study is the frequency and amount of alcohol consumption, which is not included in our data set. There is a difference between complete abstinence and moderate or high levels of alcohol consumption. Moderate and low levels of alcohol consumption are socially acceptable, while high levels of alcohol consumption are health-risk behaviors. This is the situation that causes alcohol consumption to be higher in groups with high educational attainment in the study. Other studies that also examine the frequency and amount of alcohol consumption show that while alcohol consumption is high in groups with high educational attainment, the behavior of self-harming alcohol consumption is low. However, the reason why alcohol consumption is lower in groups with low educational attainment can be explained by the fact that fundamentalist groups in rural areas of the United States abstain from alcohol consumption because of their beliefs. Another factor may be reverse causality. In other words, people may be staying away from alcohol consumption altogether because they already have health problems, but it is not possible to test this with current data.

This study also did not take into account social norms, and future research could focus on cultural and geographical differences. More rich results can be obtained when the differences between developed and developing countries are examined. The importance of genetic and environmental factors should be examined and therefore biological and ecological factors that can facilitate the establishment of causality should be identified. Another critical factor is the psychology of individuals. Under stress, health-risk behaviors

5.3. Limitations of the Study and Suggestions for Future Research

can easily change, and more meaningful results can be achieved if psychological factors such as depression and anxiety of individuals can be included.

This study can provide a solid foundation for future research. Future research can also establish the necessary causal connections by examining the correlation between educational attainment and health-risk behavior in depth by focusing on the limitations of this research. In this way, more developed public policies can be produced and public health can be increased. This situation reduces the health burden on states and improves the quality of life of individuals.

6. Conclusion

6.1. Summary of Key Findings

This study examined how health-risk behaviors have changed according to the level of educational attainment, generation, and gender. The effect of gender is evident in terms of alcohol and smoking. Women are significantly lower than men in both alcohol consumption and smoking. In these analyses conducted from the 1980s to the present, it has been found that women's alcohol consumption rates are considerably lower than men's. In both past and present times, these data have progressed very consistently. Smoking is also much lower in women than in men. Although men's alcohol consumption rates have exceeded 75% since the 1980s, this rate has been around 50% for women. There is a similar situation in smoking rates. Although the smoking rate among men was around 40% in the 1970s, this rate was lower among women, and this difference became even more pronounced in the 2000s.

When examined in terms of education, it is seen that the level of education plays an essential role in alcohol and smoking. There is a positive correlation between the level of education and alcohol consumption, while there is a negative correlation with smoking. According to the regression results, people with college education are much more likely to consume alcohol than people without education. The smoking rates of university graduates are much lower than those of high school graduates and individuals with no education. The basis of these differences in alcohol consumption and smoking are socio-economic and cultural norms. Generally, people with higher levels of education have higher income levels and social status, and alcohol consumption is a means of socialization in the social environment that develops accordingly. Alcohol is generally consumed in these social and income level activities. However, people with higher incomes and higher education are not welcome to smoke. It is not an action that people with higher health awareness tolerate, and health awareness is generally high among people with higher levels of educational attainment.

On the other hand, alcohol and smoking and the changes in attitudes of generations towards these behaviors are also interesting. Silent Generation, Baby Boomer, and Gen

6.1. Summary of Key Findings

X individuals have lower rates of alcohol use than Gen Y. While the highest rates of smoking in the 1970s and 1980s belonged to the Silent Generation and Baby Boomers, a significant decrease was observed in these rates in the 2000s; the likely reason for this is that individuals in these generations are getting older. Smoking has gradually decreased among the Baby Boomers and has reached lower levels among the Gen X and Gen Y generations.

The most significant change in alcohol consumption and smoking is the one experienced over time. Smoking behavior has decreased over time in all generations and all educational attainments from the 1970s to the present. This decrease became more pronounced in the 1990s and reached a shallow level, especially in the 2010s. This decrease is probably due to the increasing awareness of health and anti-smoking campaigns, health warnings, and taxes that increase this awareness, while the increasing educational attainment in society is also one of the main factors.

When alcohol consumption rates are examined, different results are obtained from smoking. Although alcohol consumption rates have decreased with time, this change is not as solid and evident as the decrease in smoking. Although a severe increase in alcohol consumption was observed from the 1980s to the 2010s, this increase is seen to have slowed down in the 2010s. However, alcohol consumption continues to be widespread, especially in the Y generation.

The Norwegian Institute of Public Health 2023 study also reveals similar results and findings. As a result of this study, it was observed that people with higher educational attainment consume alcohol more frequently. Individuals with a higher socio-economic status, as a combination of higher educational attainment and income, live healthier lives than others because they eat more nutritious foods and exercise more. However, studies conducted around the world have similar results; People with higher educational attainment and income drink more, and this has always been a matter of curiosity for researchers. High alcohol consumption is harmful to people and is also dangerous, such as smoking and poor nutrition.

On the other hand, alcohol, unlike these, has some social elements that people experience positively. Individuals with higher educational attainment have social environments in which alcohol consumption is more common. People in higher-income areas exercise more, live healthier lifestyles, and do not smoke, but do not see alcohol consumption as a problem. Studies show that even though people with higher educational attainment drink more frequently, they are less likely to suffer harm than people with lower educational attainment [Bye, 2023]. Studies show that alcohol-related deaths are three to four times higher in people with less educational attainment, even if they consume the same amount

6. Conclusion

of alcohol [Mellgren, 2024].

NIPH researcher Elin Kristin Bye calls this the 'Alcohol Harm Paradox'. According to this paradox, people with higher socio-economic status drink more than those with lower socio-economic status but experience much less alcohol-related harm. One reason for this is that people with lower socio-economic status tend to have riskier alcohol consumption habits. This means that they usually drink a lot at once. Another reason is that people with lower socio-economic status typically live alone because they live alone; they are far from an informal social control mechanism that would warn them when they drink too much. On the other hand, health is also poor in this social class. Some overweight people smoke more. All these factors also distance individuals from a healthy lifestyle [Rossow, 2023].

Individuals with a higher socio-economic status are often better able to avoid health-risk behaviors before they become serious health problems and harm. They are better able to break harmful habits because they have easy access to the support and help mechanisms they need. Studies on smoking in the United States have also yielded the same results as our study. In a 2021 study on smoking, 16% of adults in the United States reported smoking in the past week. On the other hand, this rate increases to 28% among those with a high school diploma, while it drops to 5% among those with a post-graduate certificate. This is not new; similar results are found when data from the last 20 years are examined. Similarly, smoking behavior is decreasing in all educational groups. When another health-risk behavior, alcohol, is discussed, the exact opposite of the pattern observed in smoking is reached. Alcohol consumption is much higher in those with a university and post-graduate education compared to those with a high school or lower education [Gilman et al., 2008].

One of the most popular theories for explaining the relationship between smoking and educational attainment is that exposure to scientific data showing a link between smoking and adverse health outcomes has led to smoking behavior. Research shows that there is little support for this hypothesis. Gallup surveyed participants about the harmfulness of tobacco. The results showed that 9 out of 10 participants with a college degree said that smoking was very harmful, while 81% of those with a high school diploma found smoking behavior very harmful. Even if all citizens of the United States had a college degree, the perception of the harmfulness of smoking would not increase significantly, although it would increase marginally. In summary, although participants with lower educational attainment levels are aware of the harmful effects of tobacco, they attach less importance to this issue than participants with higher educational attainment [Cummings and Proctor, 2014].

6.2. Contributions to Knowledge and Recommendations for Future Research

Other studies have similarly shown that increasing the number of college degrees in the United States may not reduce smoking. Adults who smoked had acquired this behavior before they entered college. Research suggests that the environment in which a person grew up, including their parents and peers, has an impact on their smoking behavior and education. If smokers had earned a college degree in their late teens, they would have continued to smoke.

Another study found that differences in smoking behaviors based on completed education were acquired long before education was received, between the ages of 12 and 18 [Maralani, 2014]. Educational inequalities in smoking are not due to education producing better health behaviors but rather to the accumulation of advantaged statuses in childhood. This is a crucial finding: A different model must be used to change smoking behaviors rather than simply increasing education attainments. The data show that young people whose parents smoke are much more likely to smoke. Children of parents who smoke are at increased risk of smoking. Another factor is the individual's peers. Young people whose smoking behavior is typical among their peers are much more likely to accept smoking behavior as normative and smoke [Vuolo and Staff, 2013].

In conclusion, the results found in our research are similar to both previous studies conducted in the United States and similar studies conducted worldwide. All studies have shown that the United States is full of inequalities in terms of education and health and that these inequalities are passed down through generations. Suppose that we want to reduce smoking behavior or make alcohol use safer and less harmful. In this case, the main goal is to improve the conditions of children growing up in families with low socio-economic status before increasing educational attainment. This will increase educational attainment, reduce smoking behavior, and make alcohol consumption safer. Although dataset limits do not include the amount and frequency of alcohol consumption and smoking, this study contributes to our understanding of the relationship between educational attainment and health-risk behavior over time.

6.2. Contributions to Knowledge and Recommendations for Future Research

This study will make a significant contribution to the literature by analyzing the correlation between educational attainment, alcohol consumption, and smoking behaviors of adults in the United States between 1970 and 2018 by generation and sex. Past studies have not examined such comprehensive factors; this study added generations to factors such as

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age, sex, and years. This study provided a detailed explanation of all aspects. The study examines generational differences and shows how generations' behaviors change over time. The fact that young generations' smoking behavior has decreased compared to previous generations and that alcohol use has not increased significantly shows that public policies are successful. This study has shown that the behavior of generations should also be considered when determining health policies.

Another contribution of this study is that although it addresses gender differences as in other studies, it examines them in more detail. It has shown that the gender difference is more pronounced in alcohol consumption and that this difference increases and decreases according to educational attainment. The gender difference in smoking is greater in people with low educational attainment. These findings have revealed how effective social norms and gender roles are in health-risk behavior. One of the most striking aspects of this study is its analysis over time. Although smoking behavior decreased with time in each education group and in total, no significant differences in alcohol consumption were observed.

Although this study expands and elaborates on previous research in many ways, many aspects still need to be completed and expanded by future research. This study focused only on the United States and needs to be stronger in cultural and geographical terms. I am observing and comparing how alcohol and smoking vary between countries and geographical regions to provide researchers with a much broader perspective. A more holistic understanding of how cultures, social norms, health policies, and economic conditions affect individuals' health-risk behavior can be achieved. In this way, a global public health strategy can be developed by calculating the prevalence of health-risk behavior in different cultures.

This study focused only on alcohol consumption and smoking. Future research will contribute to more meaningful and detailed results by including other health-risk behaviors. health-risk behavior is a spectrum, and this spectrum covers many risky behaviors such as drug use, unhealthy nutrition, risky sexual behavior, eating disorders, violence, and short duration of sleep. If future research includes these dangerous behaviors, it is essential to analyze how health-risk behavior changes over time, according to generations and time. This situation helps us to look at it from a broader health policy framework. Longitudinal studies that examine the lifelong behaviors of individuals provide a more detailed understanding of changes over time. Our study used cross-sectional data for analysis. With longitudinal studies, changes in gender, educational attainment, and inter-generational differences over time can be observed much more clearly. Thanks to these studies, the effects of health policies can be tested more meaningfully.

6.2. Contributions to Knowledge and Recommendations for Future Research

This study focused on the correlation between educational attainment and health-risk behavior. The correlation between socio-economic status and health-risk behavior can be examined in the future to obtain more comprehensive results. Educational attainment is only one determinant of socio-economic status; other determinants can be income level, occupation, or even region of residence. If desired, the socio-economic status determinants can be branched out with many factors. In the future, more holistic results can be achieved by examining all these factors separately or within the framework of socio-economic status. In particular, analyzing income status and specifically the behaviors of the low-income segment is of great importance in understanding the target audience of health policies.

Examining public policies and interventions made so far in relation to health-risk behavior and evaluating them with behavioral analyzes is very important for designing future public policies. Examining tax policies, advertising bans, and public awareness campaigns on smoking behavior and evaluating their effects can guide how policies should be developed in the long term. Similarly, studies should be conducted on alcohol consumption, what policies prosperous countries have created, and how these policies can be domesticated and implemented. Successful policies against health-risk behavior should be discussed and compared in all countries. In this way, more effective public health strategies can be developed.

Examining changes in health-risk behavior over time is very important to understand how individuals are affected by policies that have been ongoing for years, to identify the factors that cause behavioral changes, or to understand the obstacles to their change. With these studies, it may be possible to examine behavioral change models and the effects of these models on health-risk behavior. Finally, it can be concluded what kind of public health policy can be developed to achieve the desired behavioral patterns in future public health policies. Finally, the results of this study provide an essential foundation for understanding the effects of educational attainment, gender, generation, and time variables on health-risk behavior. Future studies will develop this foundation and contribute to the development of the most appropriate public health policy to be built on this foundation.

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A. Appendix

```
# NOTE: To load data, you must download both the extract's data and the DDI
# and also set the working directory to the folder with these files
(or change the path below).
```

```
if (!require("ipumsr")) stop("Reading IPUMS data into R requires the ipumsr package. It
```

```
ddi <- read_ipums_ddi("./nhis_00006.xml")
data <- read_ipums_micro(ddi)
```

```
if (!require("pacman")) install.packages("pacman")
```

```
pacman::p_load(
  tidyverse,
  ggplot2,
  ggpattern,
  stargazer,
  equatiomatic
  #, googlesheets4
)
```

```
selected_data <- data %>%
  select(YEAR, EDUCREC2, ALC1YR, SMOKESTATUS1, SMOKESTATUS2, AGE, SEX) %>%
  filter(AGE >= 25 & AGE <= 60) %>%
  filter(SEX %in% c(1,2)) %>%
  mutate(SEX = factor(SEX, levels=c(1,2), labels=c('MALE', 'FEMALE')))
```

```
# SMOKESTATUS1
```

```
# 0
```

NIU

```
# 10
```

Never smoked [NON-SMOKER]

20 Current smoker [SMOKER]
30 Former smoker [NON-SMOKER]
31 Former regular smoker [NON-SMOKER]
32 Former occasional smoker [NON-SMOKER]
90 Unknown smoking status
91 Unknown if ever smoked 100 cigarettes
92 Smoked 100 cigarettes, unknown if currently smoke

SMOKESTATUS2

0 NIU
10 Current smoker [SMOKER]
11 Current every day smoker [SMOKER]
12 Current some day smoker [SMOKER]
13 Current smoker, unknown how often smokes [SMOKER]
20 Former smoker [NON-SMOKER]
30 Never smoked [NON-SMOKER]
40 Has smoked, current smoking status unknown
90 Unknown if ever smoked

EDUCREC2

0 NIU [NO-EDUC]
10 Never attended/kindergarten only [NO-EDUC]
20 Grade 1, 2, 3, or 4 [PRIMARY]
30 Grade 5, 6, 7, or 8 [PRIMARY]
31 Grade 5, 6, or 7 [PRIMARY]
32 Grade 8 [PRIMARY]
40 Grade 9, 10, 11, or 12 [HIGH-SCHOOL]
41 Grade 9, 10, or 11 [HIGH-SCHOOL]
42 Grade 12 [HIGH-SCHOOL]
50 1 to 4 years of college [COLLEGE]
51 1 to 3 years of college [COLLEGE]
52 1 to 2 years of college [COLLEGE]
53 3 to 4 years of college [COLLEGE]
54 4 years college/Bachelor's degree [COLLEGE]
60 5+ years of college [COLLEGE]
96 Unknown-not reported

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```
# 97                                Unknown-refused
# 98                                Unknown-not ascertained
# 99 Unknown (1996 forward - Don't know)

data_smoke_status_merged <- selected_data %>%
  filter(SMOKESTATUS1 %in% c(10, 20, 30, 31, 32, NA)) %>%
  filter(SMOKESTATUS2 %in% c(10, 11, 12, 12, 20, 30, NA)) %>%
  mutate(SMOKESTATUS1_ = ifelse(!is.na(SMOKESTATUS1), ifelse(SMOKESTATUS1 %in% c(20), 1,
  mutate(SMOKESTATUS2_ = ifelse(!is.na(SMOKESTATUS2), ifelse(SMOKESTATUS2 %in% c(10, 11,
  mutate(SMOKESTATUS = ifelse(is.na(SMOKESTATUS1_), SMOKESTATUS2_, SMOKESTATUS1_)) %>%
  mutate(SMOKESTATUS = factor(SMOKESTATUS, levels=c(0,1), labels=c('NON-SMOKER', 'SMOKE
  select(-c(SMOKESTATUS1, SMOKESTATUS2, SMOKESTATUS1_, SMOKESTATUS2_))

data_clean_smoking_educ <- data_smoke_status_merged %>%
  filter(!EDUCREC2 %in% c(99, 98, 97, 96)) %>%
  mutate(EDUCREC2_ = ifelse(is.na(EDUCREC2), NA,
    ifelse(EDUCREC2 %in% c(0, 10), 0,
      ifelse(EDUCREC2 %in% c(20, 30, 31, 32), 1,
        ifelse(EDUCREC2 %in% c(40, 41, 42), 2,
          ifelse(EDUCREC2 %in% c(50, 51, 52, 53),
mutate(EDUC = factor(EDUCREC2_, levels=c(0,1,2,3,4), labels=c('NO-EDUC', 'PRIMARY', '
  select(-c(EDUCREC2, EDUCREC2_))

# Clean up alcohol usage column
data_clean_smoking_educ_alc <- data_clean_smoking_educ %>%
  filter(ALC1YR %in% c(1,2, NA)) %>%
  mutate(ALCOHOL = factor(ALC1YR, levels = c(1,2), labels = c('NO', 'YES')))) %>%
  select(-ALC1YR)

# Clean up if
# both alcohol and smoking columns are missing
# or education level is missing
data_clean_smoking_educ_alc <- data_clean_smoking_educ_alc %>%
  filter(!is.na(EDUC)) %>%
  filter(!(is.na(ALCOHOL) & is.na(SMOKESTATUS)))
```

```

check_interval <- function(value, lower, upper) {
  return(value >= lower & value <= upper)
}

# Add generation column
data_clean_smoking_educ_alc_gen <- data_clean_smoking_educ_alc %>%
  mutate(BIRTH_YEAR = YEAR - AGE) %>%
  mutate(GENERATION = ifelse(check_interval(BIRTH_YEAR, 1910, 1924), 0, # Greatest
                             ifelse(check_interval(BIRTH_YEAR, 1925, 1945), 1, # Silent
                                     ifelse(check_interval(BIRTH_YEAR, 1946, 1964), 2, # Boomer
                                             ifelse(check_interval(BIRTH_YEAR, 1965, 1979), 3,
                                                    ifelse(check_interval(BIRTH_YEAR, 1980, 199
                                                                                                     )))))) %>%
  mutate(GENERATION = factor(GENERATION, levels=c(0,1,2,3,4,5), labels=c('GREATEST', 'SILENT', 'BOOMER', 'SILENT', 'BOOMER', 'SILENT'))

# Build graphs on smoking
data_clean_smoking <- data_clean_smoking_educ_alc_gen %>%
  select(-ALCOHOL) %>%
  drop_na() %>%
  group_by(YEAR, EDUC, SMOKESTATUS, SEX, GENERATION) %>%
  count()

data_clean_smoking_10_years <- data_clean_smoking %>%
  group_by(EDUC, SEX, SMOKESTATUS, GENERATION, BASE_10_YEAR=floor(YEAR/10)*10) %>%
  summarise(MEAN=mean(n), .groups = "drop")

ggplot(data_clean_smoking_10_years, aes(fill=EDUC, y=MEAN, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity") +
  facet_wrap(~ SMOKESTATUS)

data_clean_smoking_rate_10_years <- data_clean_smoking_10_years %>%
  spread(SMOKESTATUS, MEAN) %>%
  mutate(SMOKING_RATE = SMOKER / (SMOKER + 'NON-SMOKER')) %>%
  select(EDUC, BASE_10_YEAR, SMOKING_RATE, SEX, GENERATION)

ggplot(data_clean_smoking_rate_10_years, aes(fill=EDUC, y=SMOKING_RATE, x=BASE_10_YEAR)) +

```

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```
geom_bar(position="dodge", stat="identity")

ggplot(data_clean_smoking_rate_10_years, aes(fill=GENERATION, y=SMOKING_RATE, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity")

# ggplot(data_clean_smoking_rate_10_years, aes(y=SMOKING_RATE, x=BASE_10_YEAR)) +
#   geom_bar_pattern(
#     aes(pattern=EDUC, pattern_angle = EDUC, pattern_spacing = EDUC),
#     fill      = 'white',
#     colour   = 'black',
#     position="dodge",
#     stat="identity",
#     pattern_density = 0.020,
#     pattern_fill     = 'black',
#     pattern_colour   = 'black') +
#   theme_bw() +
#   scale_pattern_spacing_discrete(range = c(0.01, 0.05))

ggplot(data_clean_smoking_rate_10_years, aes(fill=EDUC, y=SMOKING_RATE, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity") +
  facet_wrap(~ SEX)

# Experimental
# data_clean_smoking_rate_10_years %>%
#   group_by(EDUC) %>%
#   mutate(DIFF = -(SMOKING_RATE - lag(SMOKING_RATE))) %>%
#   drop_na() %>%
#   ggplot(aes(fill=EDUC, y=DIFF, x=BASE_10_YEAR)) +
#   geom_bar(position="dodge", stat="identity")

# Build graphs on alcohol
data_clean_alc <- data_clean_smoking_educ_alc_gen %>%
  select(-SMOKESTATUS) %>%
  drop_na() %>%
  group_by(YEAR, EDUC, ALCOHOL, SEX, GENERATION) %>%
  count()
```

```

data_clean_alc_10_years <- data_clean_alc %>%
  group_by(EDUC, ALCOHOL, SEX, GENERATION, BASE_10_YEAR=floor(YEAR/10)*10) %>%
  summarise(MEAN=mean(n), .groups = "drop")

ggplot(data_clean_alc_10_years, aes(fill=EDUC, y=MEAN, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity") +
  facet_wrap(~ ALCOHOL)

data_clean_alc_rate_10_years <- data_clean_alc_10_years %>%
  spread(ALCOHOL, MEAN) %>%
  mutate(ALCOHOL_RATE = YES / (YES + NO)) %>%
  select(EDUC, BASE_10_YEAR, ALCOHOL_RATE, SEX, GENERATION)

ggplot(data_clean_alc_rate_10_years, aes(fill=EDUC, y=ALCOHOL_RATE, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity")

ggplot(data_clean_alc_rate_10_years, aes(fill=GENERATION, y=ALCOHOL_RATE, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity")

ggplot(data_clean_alc_rate_10_years, aes(fill=EDUC, y=ALCOHOL_RATE, x=BASE_10_YEAR)) +
  geom_bar(position="dodge", stat="identity") +
  facet_wrap(~ SEX)

## Totals

total_data_count <- data_clean_smoking_educ_alc_gen %>% count()

total_data_sex_counts <- data_clean_smoking_educ_alc_gen %>%
  count(SEX)

total_data_generation_counts <- data_clean_smoking_educ_alc_gen %>%
  count(GENERATION)

```

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```
data_smoking_count <- data_clean_smoking_educ_alc_gen %>%
  select(-ALCOHOL) %>%
  drop_na() %>%
  count()

data_alcohol_count <- data_clean_smoking_educ_alc_gen %>%
  select(-SMOKESTATUS) %>%
  drop_na() %>%
  count()

## Smoking by years

data_smoking_10_years <- data_clean_smoking_educ_alc_gen %>%
  select(-ALCOHOL) %>%
  drop_na() %>%
  mutate(BASE_10_YEAR=floor(YEAR/10)*10)

data_smoking_10_years_count <- data_smoking_10_years %>%
  count(BASE_10_YEAR)

data_smoking_10_years_educ_count <- data_smoking_10_years %>%
  group_by(BASE_10_YEAR, EDUC) %>%
  count()

data_smoking_10_years_educ_rate <- data_smoking_10_years_educ_count %>%
  ungroup() %>%
  group_by(BASE_10_YEAR) %>%
  mutate(percentage = n * 100 / sum(n))

data_smoking_10_years_educ_sex_rate <- data_smoking_10_years %>%
  group_by(BASE_10_YEAR, EDUC, SEX) %>%
  count() %>%
  ungroup() %>%
  group_by(BASE_10_YEAR) %>%
  mutate(percentage = n * 100 / sum(n))
```

```

## Alcohol by years

data_alc_10_years <- data_clean_smoking_educ_alc_gen %>%
  select(-SMOKESTATUS) %>%
  drop_na() %>%
  mutate(BASE_10_YEAR=floor(YEAR/10)*10)

data_alc_10_years_count <- data_alc_10_years %>%
  count(BASE_10_YEAR)

data_alc_10_years_educ_count <- data_alc_10_years %>%
  group_by(BASE_10_YEAR, EDUC) %>%
  count()

data_alc_10_years_educ_rate <- data_alc_10_years_educ_count %>%
  ungroup() %>%
  group_by(BASE_10_YEAR) %>%
  mutate(percentage = n * 100 / sum(n))

data_alc_10_years_educ_sex_rate <- data_alc_10_years %>%
  group_by(BASE_10_YEAR, EDUC, SEX) %>%
  count() %>%
  ungroup() %>%
  group_by(BASE_10_YEAR) %>%
  mutate(percentage = n * 100 / sum(n))

# Upload statistics tables to google sheets
# gs4_auth()

# sheet_url <- gs4_create("data_smoking_10_years_educ_sex_rate",
#                           sheets = list(
#                             "Smoking 10 years counts and rates by education and sex" = data_s
#                           ))
# print(sheet_url)

# Correlation Analysis

```

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```
# data_alc_10_years %>%
#   group_by(EDUC, ALCOHOL) %>%
#   count() %>%
#   ungroup() %>%
#   spread(ALCOHOL, n, sep="_") %>%
#   mutate(ALCOHOL_USAGE_RATE = ALCOHOL_YES / (ALCOHOL_YES + ALCOHOL_NO))

# data_alc_rate_by_10_year_educ_sex <- data_alc_10_years %>%
#   group_by(BASE_10_YEAR, EDUC, SEX, ALCOHOL) %>%
#   count() %>%
#   ungroup() %>%
#   spread(ALCOHOL, n, sep="_") %>%
#   #group_by(BASE_10_YEAR) %>%
#   mutate(ALCOHOL_USAGE_RATE = ALCOHOL_YES / (ALCOHOL_YES + ALCOHOL_NO))

# Logistic Regression
model_alc <- glm(ALCOHOL ~ SEX + EDUC + BASE_10_YEAR,
                 data = data_alc_10_years,
                 family = binomial)
summary(model_alc)
stargazer(model_alc, type = "latex", title = "Logistic Regression Results of Alcohol Us
          out = "outputs/model_alc_summary.tex", single.row = TRUE)
eq_alc <- extract_eq(model_alc)

model_smoking <- glm(SMOKESTATUS ~ SEX + EDUC + BASE_10_YEAR,
                    data = data_smoking_10_years,
                    family = binomial)
summary(model_smoking)
stargazer(model_smoking, type = "latex", title = "Logistic Regression Results of Smokin
          out = "outputs/model_smoking_summary.tex", single.row = TRUE)
eq_smoking <- extract_eq(model_smoking)

# generations included
model_alc_gen <- glm(ALCOHOL ~ SEX + EDUC + GENERATION + BASE_10_YEAR,
                    data = data_alc_10_years,
```

```

        family = binomial)
summary(model_alc_gen)
stargazer(model_alc_gen, type = "latex", title = "Logistic Regression Results of Alcohol Usage",
          out = "outputs/model_alc_gen_summary.tex", single.row = TRUE)
eq_alc_gen <- extract_eq(model_alc_gen)

model_smoking_gen <- glm(SMOKESTATUS ~ SEX + EDUC + GENERATION + BASE_10_YEAR,
                        data = data_smoking_10_years,
                        family = binomial)
summary(model_smoking_gen)
stargazer(model_smoking_gen, type = "latex", title = "Logistic Regression Results of Smoking",
          out = "outputs/model_smoking_gen_summary.tex", single.row = TRUE)
eq_smoking_gen <- extract_eq(model_smoking_gen)

```