The Effect of Education Level and Income Level on the Diagnosis of Stroke in Mississippi

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Abstract

Mississippi has one of the nation's highest heart attack and stroke mortality rates (Mississippi Department of Health, 2019). Mississippi's educational opportunity and education levels are below the national average (Center, E. W. R. 2021). Meanwhile, Mississippi continues to have one of the nation's highest rates of poverty and income inequality (Nave & Nave, 2017). However, few studies have investigated the relationship between stroke diagnosis, income, and education level in the Mississippi population. This study aimed to examine the association between self-reported stroke diagnoses and education and income levels in the Mississippi population aged 18 years and older. This study used a questionnaire from the 2020 Behavioral Risk Factor Surveillance System (BRFSS) as a survey tool to collect and analyze participants' secondary data information on stroke diagnosis, education level, and income level. Both research questions passed the chi-square test of independence to determine the relationship between variables. The findings showed that education and income levels were significantly associated with self-reported stroke diagnoses in Mississippi people 18 years of age and older.

Keywords: Mississippi, population 18 and over, stroke, education level, income level.

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Literature Review

Types of Strokes

A Stroke is defined as a neurological disorder characterized by blocked blood vessels (Diji Kuriakose, & Zhicheng Xiao, 2020). When the blood supply to a part of the brain is suddenly interrupted or a blood vessel in the brain ruptures, blood spills into brain cells. Brain cells die when they can no longer receive oxygen and nutrients from the blood, or a sudden hemorrhage occurs in or around the brain (U.S. Department of Health and Human Services, 2021). Strokes are divided into three main types: hemorrhagic Stroke, transient ischemic attack, and the most common, ischemic Stroke (Cannon, 2020).

A hemorrhagic stroke is caused by a ruptured blood vessel in the brain, which occurs when the blood vessels supplying the brain rupture and bleed (Oosterveer et al., 2022). When blood vessels in the brain rupture and seep into the brain, brain cells and tissues do not get oxygen and nutrients. In addition, bleeding can cause increased pressure in surrounding tissue, and irritation and swelling can occur, which can lead to further brain damage (Oosterveer et al., 2022). Hemorrhagic stroke accounts for approximately 10-15% of all strokes.

Transient ischemic attack (TIA) is defined as temporary neurological dysfunction caused by focal brain, spinal or retinal ischemia without acute infarction (Yang et al., 2021). The TIA is the most important independent risk factor and the most critical early warning sign of ischemic Stroke (Yang et al., 2021). About one-third of TIA patients have cerebral infarction, most of which occur within seven days (Yang et al., 2021).

Finally, an ischemic stroke is a common cerebrovascular event due to sudden occlusion of a cerebral artery, resulting in hypoperfusion, which leads to edema, inflammation, and necrosis of the affected tissue, severely impairing neurological function (Zhang et al., 2022). According to the World Health Organization report, ischemic stroke is the leading cause of death and long-term disability globally, causing a substantial psychological and economic burden to patients (Zhang et al., 2022).

Global Rate of Stroke

Stroke remains an immense public health problem globally. Surveys show that in 2019, stroke was the second leading cause of death and disability globally (Owolabi et al., 2021). Over the past five decades (from 1970 to 2019), stroke incidence, prevalence, and mortality in low- and middle-income countries have grown much faster than in high-income countries (Owolabi et al., 2021). The medical burden of stroke is increasing in low- and middle-income countries due to limited and uneven distribution of healthcare resources (Owolabi et al., 2021). In 2019, there were 12.2 million stroke cases worldwide, and 65,500 stroke deaths (Feigin et al., 2021). From 1990 to 2019, the number of deaths due to stroke has increased significantly every year, so this has led to an increasing medical burden caused by stroke globally, especially in low-income countries (Feigin et al., 2021).

U.S. Rates of Stroke

Stroke is one of the leading causes of death and disability in the United States. Each year, approximately 795,000 strokes occur in the United States and 137,000 people die, of which ischemic strokes account for approximately 85-90% of all

strokes, while hemorrhagic strokes account for the remaining 10-15% (U.S. Department of Health and Human Services, 2022). According to the American Heart Association (2022), in 2019, there were approximately 460,000 strokes in the United States (two-thirds of which were ischemic strokes) and approximately 190,000 stroke-related deaths (American Heart Association, 2022). From 1990 to 2019, the prevalence of strokes in the general population increased by about 60% (American Heart Association, 2022). However, the U.S. stroke rate has declined in adults 75 and older, yet increases have been seen in adults 49 and younger (American Heart Association).

Strokes in Mississippi

On average, more than 1,700 people die from stroke each year in Mississippi (Mendy et al., 2019). In 2016, stroke was among the top 10 causes of death in Mississippi, accounting for 5.4% of deaths (Mendy et al., 2019). Mississippi's 2016 stroke death rate was 1.4 times the national stroke death rate (Mendy et al., 2019). In 2000, Mississippi had the sixth-highest age-adjusted stroke death rate in the U.S., which increased to the second highest age-adjusted stroke death rate in 2016 (Mendy et al., 2019). According to a 2014 report by the Mississippi Department of Health, Stroke is one of the higher-cost diseases, with an estimated $131 million in hospital discharge costs reported in Mississippi in 2010, and the medical burden of stroke is increasing (Ashley, C., & Berry, S. D., 2020).

The Relationship between Stroke and Education Level

Educational attainment is a common indicator of socioeconomic status and is recognized as an essential determinant of health outcomes, including mortality,

coronary heart disease, and Stroke (Che et al., 2020). Low educational attainment is often associated with a higher prevalence of cardiovascular risk factors. Low educational attainment is considered to be a proxy for limited access to medical services and increased psychological stress, which may lead to increased stroke risk and the development of more severe Stroke (Che et al., 2020). Due to the lack of knowledge of stroke prevention in the less educated population, the lack of knowledge on how to prevent a stroke from reducing the risk of stroke, and the lack of awareness of the onset of stroke, the optimal timing of treatment is missed. (Tiótrefis et al. 2012). However, one study showed that Stroke or a TIA increases the risk of dementia in people with low and intermediate education but not in people with high education (Mirza et al., 2016). In addition, people with higher education scored higher on cognitive tests before and after Stroke or TIA; thus, they had less decline in memory and executive function after Stroke or TIA than people with lower education (Mirza et al., 2016). Well-educated people with higher cognitive abilities are more resistant to damage from Stroke or TIA (Mirza et al., 2016). One study found that there was no significant trend toward lower disability rates among patients with higher education from six months to five years after stroke suggesting a significant relationship between higher education and good functional outcomes (Bettger et al., 2014). In addition, an association with increased stroke mortality was found in less educated individuals, which may be due to a lack of awareness of stroke onset and missed the time for optimal treatment leading to poor outcomes in the least-educated population (Wang et al., 2020). Moreover, the treatment and rehabilitation someone

who suffered a stroke is a long-term process, and patients with higher education levels may undergo effective treatment and rehabilitation (Wang et al., 2020).

In summary, studies have shown that low education attainment is associated with an increased risk of stroke in both men and women regarding the risk of having a stroke (Jackson et al., 2018). Further findings showed a strong association relationship between increased educational attainment and reduced ischemic stroke, with a significantly lower risk of ischemic stroke for every 3.6-year increase in years of education (Gao et al., 2022). A growing body of evidence supports that low education is associated with an increased risk of stroke. One analysis reported that those with less than 11 years of education increased the relative risk of stroke by one-third compared to those with 11 or more years of education (Xiuyun et al., 2020).

The Relationship between Stroke and Income Level

Income as a socioeconomic indicator can be used to predict stroke morbidity and stroke mortality. Research findings suggest that high-income individuals have a lower risk of death from stroke compared to low-income individuals (Ahacic et al., 2012). Evidence suggests that not only is income level associated with stroke and associated risk factors, and stroke incidence at a young age, but that lower income levels are associated with increased stroke severity and mortality (Avan et al., 2019). Studies have shown that health inequalities among stroke patients exist across income groups, with lower income groups associated with higher 28-day and 1-year stroke mortality (Marshall et al., 2015). a study reported that low income might be associated with increased ischemic stroke mortality during a one-year follow-up period compared with high-income individuals (Yan et al., 2017). Another study

showed significant differences in stroke morbidity and mortality across income groups, leading to inequalities between stroke-free and stroke-affected lifespans. Compared with the low-income group, the high-income group had a 25% reduction in the risk of stroke, an 18% reduction in the risk of death after stroke, and a 36% reduction in non-stroke mortality, according to German statutory insurance benefit data (Tetzlaff et al., 2020). Stroke care and prevention are more accessible among individuals with higher incomes and are more conducive to stroke monitoring and receiving emergency treatment (Owolabi et al., 2021). On the other hand, because low-income groups do not have a stable source of income, they do not have access to the same level of care or the latest prevention methods and diagnostic tools as high-income groups, resulting in higher stroke prevalence in low-income groups (Jeong et al., 2020). As such, having a low income is also associated with stroke risk behaviors such as smoking, obesity, physical inactivity, etc., which have adverse effects on Stroke (Jeong et al., 2020). The incidence of stroke was also found to increase with decreasing income levels, and the relative rates of total stroke and ischemic stroke rates in women increased with decreasing income levels across all age groups (Seo et al., 2014). At the same time, the relative proportion of hemorrhagic stroke incidence among men under 75 also increased with decreasing income levels (Seo et al., 2014). A Canadian study showed a strong association between an individual's household income and stroke risk, finding that stroke risk gradually decreased as income went from low to moderate to high (Bird et al., 2017). More specifically, 3.1% of low-income residents suffered from a stroke, compared with 0.7% of moderate and high-income residents (Bird et al., 2017). In addition, having a lower income has been

shown to negatively impact waiting times and access to rehabilitation services for stroke victims (Bird et al., 2017). Not only did low-income patients wait 30 days longer for treatment, but they were also less likely to receive physical therapy, occupational therapy, and speech therapy compared to high-income patients (Bird et al., 2017). Finally, a Swiss study found that 8-28 days post-stroke and 29-365 days post-stroke, patients with low or middle-income levels had a higher case fatality rate (CFR) than those in high-income groups (Lindmark et al., 2014).

Conclusion

A stroke occurs when a blood clot blocks the blood supply to part of the brain or when a blood vessel in the brain bursts (Centers for Disease Control and Prevention [CDC], 2021a). In either case, parts of the brain become damaged or die. A stroke can cause lasting brain damage, long-term disability, or death. (CDC, 2021a). According to CDC statistics, someone in the United States has a stroke every 40 seconds; every 4 minutes, someone dies of a stroke (CDC, 2021b). Mississippi has one of the highest rates of stroke incidence and stroke mortality in the United States (Mississippi Department of Health, 2019). Stroke is one of the state's top five causes of death, claiming about 1,500 Mississippians each year (Mississippi State Department of Health, 2018).

Epidemiological evidence indicates that low education levels were linked to stroke incidents (Xiuyun et al., 2020). Specifically, research shows that low education may lead to more severe strokes and depression (Backhouse et al., 2018). Research indicates a protective association between high educational levels, major depressive disorder, and Stroke (Yuan et al., 2021). However, public education in Mississippi is

ranked last in the nation year after year (Lynch, 2016). And in 2019, Mississippi was below the national average for educational opportunities, state investment in education, and education levels across the nation (Center, E. W. R. 2021).

A study demonstrates the importance of socioeconomic status as a predictor of stroke morbidity and stroke-related mortality (Tetzlaff et al., 2020). According to a CDC report, the age-adjusted stroke death rate for persons aged 45 and over decreased as county median household income increased (CDC, 2015). A study shows that people of lower socioeconomic status, such as low-income groups, have a higher risk of dying from a stroke than high-income groups (Ahacic et al., 2012). Overall, evidence shows that low socioeconomic status is generally associated with an increased risk of stroke. (Marshall et al., 2015). Meanwhile, Mississippi continues to have among the nation's highest rates of poverty, income inequality, and people lacking insurance as well as the lowest household incomes, new data from the federal government show. (Nave & Nave, 2017).

Few studies have investigated the relationship between stroke diagnosis, income, and education levels in the Mississippi population. Therefore, the purpose of this study is to examine the relationship between stroke diagnosis, income, and education levels in Mississippi.

Purpose of the Study

The purpose of this study is to determine whether there is a relationship between education level and income level and stroke diagnosis in the state of Mississippi. More specifically, the aim is to determine whether stroke diagnoses are higher among groups with fewer years of education compared to those with higher

education levels and whether low-income groups have a higher risk of diagnosed stroke compared to high-income groups. The findings will inform the development of health intervention programs for reducing the risk of diagnosed stroke while focusing on protecting high-risk populations.

Research Questions

The study aims to answer the following questions:

1. Is there a relationship between years of education and stroke diagnosis among adults 18 and older in the state of Mississippi?
2. Is there a relationship between levels of income and stroke diagnosis among adults 18 and older in the state of Mississippi?

Hypotheses

The first research question hypothesized that there would be a relationship between a stroke diagnosis and a person's educational level. The second research question hypothesized is that there will be a relationship between a stroke diagnosis and a person's income level.

Method

Design

This study used a cross-sectional study to measure the relationship between education level and income levels and stroke diagnosis in the state of Mississippi. This study used secondary data from the 2020 Behavioral Risk Factor Surveillance System (BRFSS).

Procedures

The Behavioral Risk Factor Surveillance System (BRFSS) is a cross-sectional telephone survey with standardized questionnaires conducted monthly by state health departments via landlines and cell phones, with technical and methodological assistance from the CDC. Its survey respondents are noninstitutionalized U.S. adults over the age of 18 (Esser et al., 2020). The BRFSS collects state data on U.S. residents' health-related risk behaviors, chronic health conditions, and use of preventive services, to better understand their risky behaviors and preventive health practices that may affect their health status (CDC, 2021c). The 2020 BRFSS dataset's landline and cell phone data sets are constructed from landline and cell phone data submitted in 2020 and include data from all 50 U.S. states, the District of Columbia, Guam, and Puerto Rico (CDC, 2021d). The BRFSS questionnaire was designed by a working group of BRFSS state coordinators and CDC staff. The questionnaire is divided into three components: (1) core components module, (2) optional modules, and (3) state-added modules. The core component module is a standard set of questions asked by all participating states, including questions about demographic characteristics, as well as inquiries about current health-related topics and current

health behaviors (such as alcohol and tobacco use, sleep duration, vaccinations, etc.) (CDC, 2021c). The 2020 BRFSS questionnaire has added sections on sexual orientation and gender identity, marijuana use, and e-cigarettes to the core components. (CDC, 2021c). The optional BRFSS module contains standardized questions created by CDC for specific topics that states choose to include in the questionnaire. State-added modules are questions that states create and place in the BRFSS questionnaire based on the need for certain information and are not edited or evaluated by the CDC (Silva, 2014).

Research has shown that although there are differences in BRFSS survey data results on some survey topics, overall, BRFSS data are considered reliable and have a high overall level of validity (Pierannunzi et al., 2013). And questions on BRFSS are cognitively tested to optimize the validity of survey responses and the clarity of variables in the questions. Likewise, BRFSS liaison officers are fully trained, and their performance is regularly assessed to ensure survey quality and improve the trustworthiness of survey data (Pickens et al., 2018). The research questions for this study were derived from the Chronic Health Conditions section and the Demographics section of the core components module of the BRFSS questionnaire. Therefore, this study will analyze the Chronic Health Conditions and Demographics parts of the core components module of the BRFSS questionnaire.

Participants

The target population for this study included all Mississippi adults aged 18 and older randomly selected from the 2020 Behavioral Risk Factor Surveillance System (BRFSS) dataset. The original dataset included a total of 6479 participants.

The participants who responded to the questions: Ever Diagnosed with a Stroke, Education Level, and Income Level were included in the analyses. The participants who missed responses, refused responses, and don't know/not sure were excluded from the dataset. As a result, a total sample size was 4794 participants. In order to effectively power the statistical tests, an intermediate effect size of 0.30, an alpha coefficient of 0.05, and a power of 80% were chosen for sample size estimations according to G* Power software version 3.1.9.7 (Kang, 2021). Based on the results, a minimum sample of 88 participants were needed.

Independent Variable

Independent variables for this study included education level and income level. For the first research question, the independent variable was education level, measured by question CDEM.06, "What is the highest grade or year of school you completed?". This variable is recorded in the BRFSS dataset as seven levels, "1-Never attend school or only Kindergarten," "2-Grades 1 through 8 (Elementary)," "3-Grades 9 through 11 (Some high school)," "4-Grade 12 or GED (High school graduate)," "5-College 1 year to 3 years (Some college or technical school)," "6-College 4 years or more (College graduate)," "9-Refused. "For the purpose of this study, education level was recorded as a dichotomous categorical variable with two levels, "1-high school or lower," "2-College 1 year to 3 years (Some college or technical school) or higher" (Dotson, 2018). Those were responded as "9-Refused" were treated as missing data.

For the second research question, the independent variable was income level and was measured by question CDEM.16, "Is your annual household income from all

sources?". This variable was recoded into ten levels in the BRFSS dataset, "1-Less than $10,000," "2-Less than $15,000 ($10,000 to less than $15,000)," "3-Less than $20,000 ($15,000 to less than $20,000)," "4-Less than $25,000 ($20,000 to less than $25,000)," "5-Less than $35,000 ($25,000 to less than $35,000)," "6-Less than $50,000 ($35,000 to less than $50,000)," "7-Less than $75,000 ($50,000 to less than $75,000), " "8-$75,000 or more," "77-Don't know/Not sure," "99-Refused." For the purpose of this study, income levels were recoded as a dichotomous categorical variable with two levels, "1-Income less than $35000," "2-Income greater than or equal to $35000," (Dotson, 2018). Those who responded as "77-Don't know/Not sure" and "99-Refused" were treated as missing data.

Dependent Variable

The dependent variable for this study were stroke diagnosis, which was measured by question CCHC.03, "(Ever told) (you had) a stroke?". This variable is recoded into four levels in the BRFSS dataset, respectively "1-Yes," "2-No," "7-Don't know/ Not sure," and "9-Refused." For the purpose of this study, stroke diagnosis was recorded as a dichotomous categorical variable with two levels, "1-Yes," "2-No," and "7-Don't know/ Not sure," "9-Refused." Were treated as missing data.

Data Analysis

IBM Statistical Package for the Social Sciences (SPSS) version 26 was used to analyze the 2020 Behavioral Risk Factor Surveillance System (BRFSS) data to answer questions and address research hypotheses. A Chi-square test of independence was performed to measure the relationship between stroke diagnosis and education

level. A Chi-square test of independence was also conducted to measure the relationship between stroke diagnosis and income level.

Results

Demographics

The sample (n = 4,794) used in this study included respondents from the 2020 Behavioral Risk Factor Surveillance System (BRFSS). As shown in Table 1, participants were mostly female (58.34%, n = 2,797) and more than half of the participants identified as white, non-Hispanic (58.99%, n = 2,828), followed by African American, non-Hispanic (37.67%, n = 1,906). Additionally, more than half of the participants were over the age of 45. Specifically, 14.60% (n = 700) were between age 45 and 54, 20.15% (n = 966) were between age 55 and 64 and 36.09% (n = 1,730) were aged 65 years or older. Of the sample, 40.2% (n=1,926) of respondents reported completing a high school degree or less and 59.8% (n = 2,868) reported completion of some college or higher. Additionally, 47.6% of respondents reported an income level of less than $35,000 (n=2,281), and 52.4% of respondents reported an income level of $35,000 or more (n=2,513). Among the respondents, 6.2% (n = 299) reported that they had been told they had had a stroke.

Major Findings

For the first research question, a chi-square test of independence was performed to measure the relationship between stroke diagnosis and education level. A significant relationship was found between stroke diagnosis and education level (X^2 (1) =35.45, p<.001). As shown in Table 2, among those living in Mississippi, the odds of those who were diagnosed with a stroke were 2.03 times higher for those who reported having an education level below high school level compared to those with some college or technical school (OR=2.026, CI=1.599, 2.566)

For the second question, A chi-square test of independence was also conducted to measure the relationship between stroke diagnosis and income level. A significant relationship was found between stroke diagnosis and income level (X^2 (1) =75.66, p<.001). Specifically, as shown in Table 2, among those living in Mississippi, the odds of being diagnosed with a stroke are 3.0 times greater for those who reported having an income of less than $35,000 compared to those with an income greater than $35,000 (OR=3.009, CI=2.323, 3.899).

Discussion

This study investigated the relationship between education level, income level, and self-reported stroke diagnoses in people aged 18 and older in Mississippi, USA. These variables were analyzed using the chi-square test of independence. According to the Chi-square test results, there was a significant relationship between self-reported educational level and income level and self-reported stroke diagnosis among people aged 18 and over in Mississippi, USA.

Education Level and Stroke

The first research question examined the relationship between stroke diagnosis and education attainment. Results indicate a significant relationship between self-reported educational level and self-reported stroke diagnosis. Participants who reported education at or below high school level had 2.03 times increased odds being diagnosed with stroke. The results of this study are consistent with those of previous studies. Previous research shows a strong association between educational attainment and stroke (Gao et al., 2022). Studies have shown that low education is more likely to lead to increased stroke risk and more severe stroke development (Che et al., 2020). Research has shown that less than 11 years of education increased the risk of stroke by one-third compared to those with 11 or more years of education (Xiuyun et al., 2020). Thus, high levels of education were found to be a protective factor against with stroke (Yuan et al., 2021). It could be speculated that due to the lack of knowledge of stroke prevention among people with low education levels, effective stroke prevention methods may be difficult to implement, and at the same time, they may have insufficient awareness of the hazards of stroke

and miss the best time for treatment (Tiótrefis et al., 2012). A study also showed that less than 11 years of education increased the risk of stroke by one-third compared to those with 11 or more years of education (Xiuyun et al., 2020). Finally, a study showed that high levels of education are a protective association factor against with Stroke (Yuan et al., 2021). Thus, improving the education level of people 18 and older in Mississippi could significantly help reduce the likelihood of stroke for individuals in this population.

Income Level and Stroke

The second research question aimed to examine the relationship between stroke diagnosis and income level. Results found a significant relationship between self-reported income level and self-reported stroke diagnosis. Participants who reported income levels below $35,000 had 3.0 times the increased odds of reporting being diagnosed with stroke. The results of this study are consistent with those of previous studies. According to previous research, there is a significant association between an individual's household income and stroke risk and an association between lower household income and higher stroke prevalence (Bird et al., 2017). Previous studies have also shown significant differences in stroke morbidity and mortality across income groups, with higher-income groups having a 25% lower risk of stroke and an 18% lower risk of death after stroke compared with lower-income groups (Tetzlaff et al., 2020). Because low-income groups do not have a stable source of income, they do not have access to the same level of care or the latest prevention methods and diagnostic tools as high-income groups, resulting in higher stroke prevalence in low-income groups (Jeong et al., 2020). Therefore, these findings

suggest that income level is an essential factor affecting stroke incidence and that increasing the income level of people 18 and older in Mississippi could help reduce the odds of being diagnosed with stroke in this population.

Public Health Implications

This study showed a significant relationship between education and income level and a stroke diagnosis in Mississippi 18 years of age and older, and that low-income groups and those with fewer years of education were more likely to be diagnosed with stroke. The findings of this study provide important insights into reducing stroke risk and protecting at-risk populations. Public health advocates need to focus on these critical populations when formulating health intervention policies to reduce stroke risk in key populations and improve the ability of target populations to prevent stroke.

Previous research suggests that the positive impact of education on stroke prevention may also come from adopting healthier lifestyle habits, such as healthy eating and exercise (Gill et al., 2019). Health educators can conduct free dietary nutrition training courses and post low-salt and low-fat diet posters in high-risk communities to enhance knowledge about stroke prevention among high-risk groups. Policymakers could provide food subsidies for low-income people and provide tax rebates for stroke-preventive foods such as fresh vegetables and fruits, encouraging low-income people to buy and eat healthy foods. Additionally, policymakers can fund physical activity programs and hire health educators to provide physical activity guidelines and programs for at-risk groups to encourage at least weekly physical

activity to lower cholesterol and blood pressure levels, thereby reducing stroke risk and increasing the likelihood of stroke prevention.

Policymakers can also advocate for free public sport facilities such as gyms and basketball courts in high-risk communities, develop physical exercise programs for high-risk groups and provide free fitness coaches and physical education classes, encouraging high-risk groups to engage in at least 40 minutes 2-3 times a week Physical activity lowers cholesterol and blood pressure levels, thereby reducing stroke risk and increasing the likelihood of stroke prevention. Policymakers can also fund or advocate for the development of free health APPs for the high-risk group community, formulate daily healthy eating plans and exercise plans based on the high-risk groups' own body data, and give monetary rewards to those who complete the plan every day.

Previous research has shown that lower income groups tend to have higher stroke rates, lower quality of stroke care, and a lack of knowledge about stroke prevention (Marshall et al., 2015). At the same time, previous studies have shown that low-income people often lack awareness of stroke risk factors such as hypertension and hyperlipidemia, leading to increased stroke risk (O'Donnell et al., 2020). Therefore, health educators can provide stroke prevention booklets and post-stroke care notebooks in low-income communities to educate low-income people on the identification of stroke risk factors and learning about stroke care. In low-income communities, policymakers can set up professional stroke prevention and care centers to provide free offline courses in stroke prevention and care, as well as free stroke care. Faced with the problem of low-quality of post-stroke care for low-income

people, public health policymakers can provide stroke care subsidies for low-income people after a stroke or reduce or exempt the cost of care for low-income people with stroke.

Study Limitations

This study has many limitations. The first major limitation is the method of data collection. Since BRFSS uses self-reported information from a sample population collected by different telephone interviewers, there may be uncertainty/ambiguity or answers given as they see fit. Respondents' self-answered questions can lead to response bias. For example, participants may be uncertain when answering questions, leading to changes in question results. Respondents may also have a social expectation bias, where respondents tend to answer in a way that makes them look good to others, regardless of whether their answer is accurate or not.

A second limitation is that this study uses only two variables, education, and income level, to judge the relationship with a stroke diagnosis. This study leads to one-sided experimental results that only consider the effects of education and income levels on stroke diagnosis. This study did not explore the relationship of other stroke risk factor variables to stroke diagnosis. For example, according to previous research, age, diet and physical activity are also risk factors for stroke risk (Gill et al., 2019, Yousufuddin & Young, 2019). However, this study failed to examine the effect of age, diet and exercise on stroke diagnosis, which would limit the results of this study.

A third limitation is that the researchers do not know whether missing data on income and education level would alter the data analysis for these two variables. Since the rejected responses and uncertain/unknown data in the income and education

level data in the BRFSS dataset are listed as missing data, these two types of missing data may lead to the sample size of the income level variable and education level variable being too large or too small, thus affect the overall experimental results.

A fourth limitation is that the cross-sectional study design has some limitations, such as the lack of longitudinal data and the inability to infer causal relationships (Solem, 2015). Cross-sectional studies require large sample sizes, and results may be affected by sampling bias, with participants ignoring potentially other variables that may affect results (Wang & Cheng, 2020). Because this study was designed to determine relationships between variables, experimental results may not identify causal relationships when cross-sectional studies are used.

Conclusion

Although there has been some research on the link between education and income level and stroke diagnosis and found some evidence that is consistent with previous research, further research on other influencing factors is needed. Further research is needed on the impact of more specific education and income levels on stroke diagnosis to further differentiate the differences between education level and income level in stroke diagnosis. Finally, further research into public health programs and improvements in primary care is needed to address socioeconomic disparities within countries, control traditional risk factors for high-risk groups, and ensure equitable access to high-quality hospital care and rehabilitation, reducing stroke risk and improving stroke prevention ability. Additionally, an independent survey of the Mississippi population 18 years and older is recommended to help understand the relationship between the Mississippi population 18 years and older and stroke.

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Appendix

Table 1

Demographic Details for Mississippi Adult Respondents to the 2020 Behavioral Risk Factor Surveillance System (N = 4,794)

	N	*%*
Gender		
Male	1997	41.7
Female	2797	58.3
Race Ethnicity		
Hispanic	39	0.8
White, Non-Hispanic (NH)	2828	59.0
African American Only, Not Hispanic	1906	37.7
American Indian/Alaskan Native Only, NH	29	0.6
Asian Only, NH	28	0.6
Other/Two or More Races	27	0.6
Age		
18 - 24	205	4.3
25 - 34	499	10.4
35 - 44	664	13.8
45 - 54	700	14.6
55 - 64	966	20.15
65 and older	1730	36.1
Education Level		
High school graduate or less	1926	40.2
College 1 to 3 years or higher	2868	59.8
Income Level		
Income less than $35000	2281	47.6
Income greater than or equal to $35000	2513	52.4
Ever been told you have stroke		
Yes	299	6.2
No	4495	93.8

Table 2

Crosstabulation of Determinants of Stroke

	Stroke					
	Yes	No	OR	CI	$\mathbf{X^2}$	p-value
Reported education level			2.03	1.60, 2.57	35.45	.000
High school or less	169 (56.6%)	1757 (39.1%)				
College 1 to 3 years (some colleges or technical schools) or higher	130 (43.4%)	2738 (60.1%)				
Reported income level			3.01	2.32, 3.90	75.66	.000
Income less than $35000	215 (72.9%)	2066 (45.9%)				
Income greater than or equal to $35000	84 (28.1%)	2429 (54.1%)				

Notes: Reported education level (n=4794), Reported income level (n=4794).