

Correlation Between Blood Glucose Levels And Risk Of Non-Hemorrhagic Stroke: Analysis Of A Prospective Cohort Study In An Elderly Population

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Abstract

Stroke is one of the main cardiovascular diseases that causes death and disability throughout the world. One of the important risk factors for stroke is hyperglycemia or high blood sugar levels. This study aims to analyze the correlation between blood glucose levels and the risk of non-hemorrhagic stroke in the elderly population. This research utilizes a qualitative approach. The data source used is the scientific literature. The data that has been collected is then analyzed through the process of data reduction, data presentation, and conclusion drawing. The research findings show that there was a significant positive correlation between blood glucose levels and the risk of non-hemorrhagic stroke in the elderly population. Elderly people with high blood glucose levels have a higher risk of non-hemorrhagic stroke compared to elderly people with normal blood glucose levels. Good control of blood glucose levels can be an important strategy to reduce the risk of non-hemorrhagic stroke in the elderly.

Keywords: Blood Glucose Levels, Elderly, Non-Hemorrhagic Stroke.

INTRODUCTION

Stroke is one of the leading causes of disability and is the third leading cause of death globally, after heart disease and cancer in both developed and developing countries. According to data from the Institute for Health Metrics and Evaluation (IHME) in 2019, stroke is the leading cause of death in Indonesia, accounting for approximately 19.42% of total deaths. Based on the Riskesdas results, the prevalence of stroke in Indonesia has increased significantly, from 7 per 1000 population in 2013 to 10.9 per 1000 population in 2018. Stroke itself is defined as clinical signs that appear suddenly or abruptly, such as focal deficits in brain function, which last for at least 24 hours or cause death in the absence of causes other than vascular factors (Mendelson & Prabhakaran, 2021).

Stroke has several classifications, one of which is non-hemorrhagic stroke. Non-hemorrhagic stroke, also known as ischemic stroke, refers to the sudden loss of brain function due to disruption of blood supply to the brain area. Non-hemorrhagic stroke can occur in the form of cerebral ischemia, embolism, or thrombosis and often occurs after a long period of rest, upon waking, or in the morning (Sonyorini & Sulastri, 2023). One element that is significant in increasing the risk of stroke is hyperglycemia or high blood sugar levels.

Hyperglycemia has a role in damaging the vascular endothelium through mechanical mechanisms and increased oxidative stress. In the acute phase of stroke, hyperglycemia can exacerbate brain damage by impairing endothelial nitric oxide synthase (eNOS) function, which results in additional oxidative stress and causes vasoconstriction and leukocyte adhesion, which in turn can lead to microvascular blockage. Tight blood glucose control is associated with reduced mortality in stroke patients whose condition is critical (Khudin et al., 2014).

Hyperglycemia can also increase blood viscosity, which in turn can increase blood pressure or hypertension, which is a major risk factor for ischemic stroke (Ramadany, 2012). Patients who have had a stroke and have high blood sugar levels have a fourfold higher risk of having another ischemic stroke compared to stroke patients who have normal blood sugar levels (Hermawan, 2022).

In the elderly, the incidence of stroke is most often caused by systemic diseases such as hypertension, hypercholesterolemia, and diabetes mellitus. In the age range of 40-70 years, every 20 mmHg increase in systolic pressure or ten mmHg increase in diastolic pressure will double the risk of stroke. In this age group, the cause of stroke is generally related to an unhealthy lifestyle that has been carried out since adolescence and continues consistently, causing chronic diseases that eventually develop into heart disease and stroke in old age. The elderly tend to be prone to hypertension and other disease complications. Data from various studies show that the incidence of stroke increases with age, where the older a person is, the higher the chance of having a stroke. Feigin et al. reported that 62% of stroke cases occurred in individuals under 70 years of age, while only 16% of cases occurred in the 15-49 age group (Rachmawati, Marshela, & Sunarno, 2022).

This study makes an important contribution to the understanding of the relationship between blood glucose levels and the risk of non-hemorrhagic stroke, particularly in the elderly population. These implications may help the development of better theories and models in understanding the pathophysiological mechanisms and risk factors involved in the occurrence of non-hemorrhagic stroke. This study aims to analyze the correlation between blood glucose levels and the risk of non-hemorrhagic stroke in the elderly population.

RESEARCH METHODS

This research adopts a qualitative approach. A qualitative method is a method that uses a research technique that emphasizes analysis and description. In qualitative research, the main emphasis is given to an in-depth understanding of the subject's perspective, and theory is used as a foundation that guides researchers in understanding the observed phenomena. The purpose of qualitative research methods is to explain phenomena clearly and comprehensively by collecting comprehensive data and exploring the various aspects involved. This method allows researchers to understand the context, meaning, and experiences experienced by participants in the study (Fadli, 2021). The data collection technique in this research is a literature study. The literature study method is a series of processes related to data collection from library sources, which include reading, recording, and managing materials relevant to the research. The type of data utilized in this study is secondary data. Data was obtained from reliable

sources such as Google Scholar, PubMed, and Scopus. After the data was collected, the analysis was conducted through three stages: data pruning, data presentation, and conclusion drawing.

RESULTS AND DISCUSSION

Old age, often referred to as old age or the elderly, is the final phase of a person's lifetime. It's a time when one has moved away from earlier, more enjoyable, or productive times. Elderly is a term used to refer to individuals who have reached the age of 60 and above, in accordance with the definition set out in the Law of the Republic of Indonesia Number 13 of 1998. Then, according to this law, the elderly have the same rights in terms of social life, nationality, and government as other age groups (Akbar et al., 2021).

According to the World Health Organization (WHO) in 1999, which was cited in research (Lumi et al., 2018), the age limit of the elderly is divided into four categories as follows:

1. Middle age, which is the age range between 45 to 59 years. This is the period in which a person has passed early adulthood and has not yet reached the elderly stage.
2. Advanced age, which is the age range between 60 to 74 years. At this stage, a person begins to enter the elderly phase, where there is an increased risk of various aging-related health issues.
3. Old age, which is the age range between 75 to 90 years. This is a more advanced phase of aging, where individuals may face more health challenges and significant physical changes.
4. Very old age, which is above 90 years of age. This is a very advanced stage of aging, where an individual may face serious health challenges and significant physical changes due to the natural aging process.

Old age is part of the last stage in the inevitable process of human development. The significant extension of life expectancy is an important achievement for humanity in surviving old age. However, with the increase in the number of elderly people (aged 60 years and above), dependency-related disorders will become more common, in line with the absolute and relative growth (in relation to the total population) of this age group (Prince et al., 2015).

The elderly are one of the groups that have increased in number and are vulnerable to certain risks. At-risk populations are categories of individuals who have the potential to experience worsening of their health conditions due to various influencing factors. This means that the elderly are people who have a higher possibility of experiencing health complications due to various factors that affect their condition (AA & Boy, 2020). According to (Dinata, 2015), the age of 60 years and above is the last stage of the aging process, which has an impact on three main aspects, namely biological, economic, and social. Biologically, elderly individuals experience a continuous aging process characterized by a decrease in physical endurance and susceptibility to potentially fatal diseases. Changes in the structure and function of cells, tissues, and organ systems are the main factors in this process.

In simpler language, when reaching the age of 60 and above, one enters the final stage of the aging process. At this age, the body experiences a decline in physical endurance and becomes more susceptible to diseases that can be fatal. This is due to changes in the structure and function of cells, tissues, and organs. One risk that often occurs in older people is the occurrence of stroke, a medical condition that can result in serious impacts on health (Lindley, 2018). Special characteristics possessed by elderly people can be a factor that triggers the occurrence of stroke (Hanum, Lubis, & Rasmaliah, 2018). The older a person gets, the higher the risk of stroke. Data shows that the prevalence of stroke increases with age, reaching around 69% in individuals over 65 years of age and around 34.4% in individuals over 75 years of age (Lo Coco, Lopez, & Corrao, 2016).

The causes of stroke can be categorized into modifiable and non-modifiable risk factors. Modifiable risk factors include conditions such as high cholesterol levels, diabetes mellitus, and high blood pressure, as well as unhealthy lifestyles such as drinking alcohol, lack of physical activity, exposure to pollution, consumption of unhealthy foods, and smoking. On the other hand, there are non-modifiable risk factors, such as age, gender, ethnicity or race, and family history of stroke (Meschia et al., 2014). People who have a stroke often experience a variety of functional impairments that include motor, psychological, or behavioral problems. One of the most characteristic symptoms is hemiparesis, which is weakness or paralysis on one side of the body, either the right or left side, depending on the location of the stroke. In addition, a person who has had a stroke may also lose the appropriate ability on the side of the body affected by the stroke, so they may have difficulty in performing daily activities (KRISNAWATI & DWI, 2023).

Sensory disturbances are also common, such as loss of sensation in the face or other parts of the body, which can affect a person's ability to sense touch or temperature. Speech difficulties are also a common symptom of stroke, where a person may have difficulty pronouncing words clearly or expressing their thoughts correctly. Loss of vision on one side of the eye or one side of the body can also result from stroke, known as hemianopsia, which can impair a person's ability to see objects or people on one side of their body (Harahap & Siringo-Ringo, 2020). All of these symptoms can have a significant impact on a person's quality of life, especially the elderly, as their body may already be experiencing decreased function and weakness.

There are two main classifications of strokes that occur in humans. One is non-hemorrhagic stroke, which is often referred to as ischemic stroke. Non-hemorrhagic stroke occurs when there is an interruption of blood circulation in the brain due to blockage of blood vessels without any bleeding. This is in contrast to the other type of stroke, namely hemorrhagic stroke, where there is bleeding in the brain. It is important to note that the majority of stroke cases that occur, approximately 83% of total patients, are non-hemorrhagic strokes (Harahap & Siringo-Ringo, 2020). This indicates a high prevalence of this type of stroke, so the study will focus on cases of this type of stroke.

More than eighty percent of stroke cases are caused by an ischemic process, which results from a thrombotic or thromboembolic blockage of an artery. Blood clots are most common in extracranial cerebral arteries, the heart (associated with conditions such as atrial fibrillation, mitral valve disease, or left ventricular thrombus), small

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arteries entering the brain (known as lacunar stroke), and plaques in the aortic arch. Ischemic stroke can be divided into several types, including large artery atherothrombosis, cerebral embolism, lacunar stroke, and systemic hypoperfusion. Symptoms of ischemic stroke are usually focal neurological deficits that correspond to the distribution of the affected blood vessels. The manifestation of symptoms can be variable, and there is often a progressive decline in neurologic function or in a stepwise pattern. Symptoms such as vomiting and decreased consciousness are rare in ischemic stroke (Hanum et al., 2018).

Non-hemorrhagic stroke in the elderly can be a serious threat as there are many risk factors that influence the incidence of stroke. These risk factors include hypertension, diabetes mellitus (DM), hypercholesterolemia, smoking, alcohol consumption, atrial fibrillation, as well as other factors such as obesity, physical activity level, drug use, and oral contraceptive use (Hardika et al., 2020). In the case of the elderly, these factors can be more complex as their bodies tend to undergo physical and metabolic changes that affect stroke risk.

Knowing the risk factors that cause non-hemorrhagic stroke is important to prevent the possibility of occurrence, especially in the elderly population. One risk factor that needs to be considered is maintaining blood glucose levels within a normal range. This is because high blood glucose levels, or hyperglycemia, is often found in stroke patients and is associated with lower survival rates. Several studies have shown that acute ischemic stroke patients who experience hyperglycemia have a higher mortality rate. In fact, there is a study that states that patients with equivalent blood glucose levels, either with or without a history of diabetes, have equivalent outcomes in terms of acute ischemic stroke outcomes (Hanjaya et al., 2019).

Glucose levels in the blood are the main source of energy for the body's cells. Normally, blood glucose levels are in the range of 70-150 mg/dL, with an increase after meals and reaching its lowest point in the morning before food consumption. Balanced blood glucose levels are essential for maintaining optimal body function. This regulation of glucose levels is mainly governed by the hormone insulin, which lowers blood glucose levels, and the hormone glucagon, which increases blood glucose levels (Wulandari & Kurnianingsih, 2018). Experts agree that blood glucose levels above 150 mg/100 ml may increase the risk of atherothrombotic brain infarction, especially in elderly women, who tend to have a higher risk than men. This condition becomes an independent risk factor that contributes to the increased incidence of stroke in elderly women (WATTIMENA, 2017).

There is a significant relationship between elevated blood glucose levels and the risk of stroke. Elevated blood glucose levels, or hyperglycemia, can worsen acidosis conditions due to the accumulation of lactic acid, which increases the production of free radicals and disrupts intracellular signal transduction processes and endonuclease activation. This can lead to more extensive damage to brain tissue. In addition, hyperglycemia can also stimulate the release of certain amino acids, especially glutamate, which has an important role in activating postsynaptic glutamate receptors, particularly NMDA (N-methyl-D-aspartate) receptors. Based on research (Hanjaya et al., 2019), it is concluded that high blood glucose levels can double the risk of stroke compared to patients who have good blood glucose control.

Stroke patients who experience hyperglycemia have the potential to worsen their stroke condition compared to those who have normal blood glucose levels. According (Hermawan, 2022) found that there was a correlation between blood glucose levels and stroke incidence rates at RSI Sultan Agung Semarang. High blood glucose levels increase the risk of recurrent ischemic stroke. Stroke patients who have high blood glucose levels have a four-fold higher risk of re-ischemic stroke compared to those with normal blood glucose levels.

The relationship between blood glucose levels and non-hemorrhagic stroke may also be influenced by obesity, which is one of the risk factors for non-hemorrhagic stroke. Obesity is closely related to increased blood pressure and high blood glucose levels. When a person is obese, the heart has to work harder to pump blood throughout the body, which can lead to increased blood pressure. In addition, obesity also tends to cause chronic inflammation in the body and can affect glucose metabolism. This can lead to insulin resistance, where the body's cells become less responsive to insulin, which can lead to increased blood glucose levels. The combination of high blood pressure, uncontrolled blood glucose levels, and chronic inflammation can increase the risk of non-hemorrhagic stroke (Hardika et al., 2020).

Based on these results, it can be said that there is a significant correlation between blood glucose levels and non-hemorrhagic stroke, which also applies to the elderly population. Research conducted by (Kurniawati et al., 2021) showed that there is a relationship between blood glucose levels and blood pressure and the risk of stroke in the elderly. This means that high blood glucose levels in the elderly can contribute to increased blood pressure, which in turn increases the risk of stroke. This finding emphasizes the importance of monitoring and controlling blood glucose levels in the elderly as part of stroke prevention strategies.

Therefore, optimal control of blood glucose levels is an important strategy in an effort to reduce the risk of non-hemorrhagic stroke in the elderly population. (Karno, 2023) describes several complementary therapies that have been recognized in Indonesia as potentially effective in helping to lower blood glucose levels. These therapies include the consumption of boiled water of various ingredients such as bitter melon, gambas vegetable, guava leaf, kersen leaf, bengkuang starch juice, bay leaf and red ginger herbal tea, and acacia leaf decoction drink. Other complementary therapies mentioned include Benson relaxation, foot reflexology and foot exercises, acupressure, yoga, hydrotherapy, and aromatherapy.

Consumption of boiled water from ingredients such as bitter melon, gambas vegetable, guava leaf, kersen leaf, bengkuang starch juice, bay leaf and red ginger herbal tea, and acacia leaf boiled water has been proven effective in reducing blood glucose levels. In addition, the Benson relaxation technique, which is a combination of relaxation with the patient's beliefs, can help patients to feel relaxed and calm, thus reducing blood glucose levels. Foot reflexology and foot exercises also reduce blood sugar levels by increasing the smooth flow of the spleen. Acupressure techniques can reduce blood glucose by activating carbohydrate metabolism enzymes, increasing insulin synthesis in the pancreas, increasing target cell receptors, and increasing blood sugar utilization in cells.

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Meanwhile, yoga therapy is a physical exercise that provides calmness and reduces stress so that it can cause a decrease in blood glucose levels. Hydrotherapy, which is water therapy, involves drinking 1.5 liters of water every morning after waking up and can also help break down blood sugar in the body. Aromatherapy therapy using lavender has also been proven effective in lowering blood glucose levels in diabetic patients. This aromatherapy contains linalool acetate, which is sedative and anti-neurodepressive, able to weaken the nervous system and tense muscles and provide calmness.

Thus, given the correlation between blood glucose levels and the incidence of non-hemorrhagic stroke in the elderly, attention to controlling blood glucose levels may be an effective measure in preventing non-hemorrhagic stroke in this age group. Various therapeutic options and strategies available to lower blood glucose levels may help in managing the risk of non-hemorrhagic stroke, especially in the elderly population.

CONCLUSIONS

The results confirmed a significant positive correlation between blood glucose levels and the risk of non-hemorrhagic stroke in the elderly population. Elderly who have high blood glucose levels tend to have a higher risk of non-hemorrhagic stroke compared to those who have blood glucose levels within the normal range. Therefore, good blood glucose control is an important strategy in reducing the risk of non-hemorrhagic stroke in the elderly population. Thus, attention to blood glucose control can be one of the effective measures in preventing non-hemorrhagic stroke in the elderly.

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