Identification of the Seasonal Variations and Types of Stroke Occurrence

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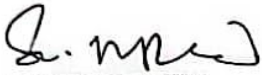
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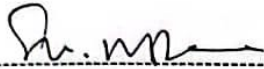
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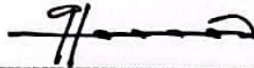BHPI, CRP, Savar, Dhaka
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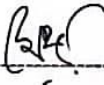
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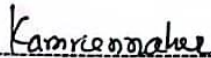--

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List of Abbreviations

BHPI: Bangladesh Health Professions Institute

BMRC: Bangladesh Medical Research Council

GBD: Global Burden Disease

HICs: Higher Income Countries

ICH: Intracerebral Hemorrhage

IRB: Institutional Review Board

IS: Ischemic Stroke

LICs: Lower Income Countries

SAH: Subarachnoid Hemorrhage

SD: Standard Deviation

TIA: Transient Ischemic Attack

UMICs: Upper Middle-Income Countries

WHO: World Health Organization

Abstract

Introduction: Stroke is the third most prevalent reason of mortality in Bangladesh and one of the main causes of chronic illness globally. There is ongoing debate on the effect of seasonal differences on stroke incidence. This study aimed to identify the seasonal variations and types of stroke occurrence.

Method: Cross-sectional research was carried out with 1051 stroke victims at the Neurology & Medicine Department Unit of Shaheed Suhrawardy Medical College & Hospital, Dhaka. Secondary data were used in this study and this secondary data was collected from medical records of the Neurology & Medicine unit of Shaheed Suhrawardy Medical College's admission book dated from April 2023 to March 2024. From admission books, the diagnoses of intracerebral hemorrhage, ischemic stroke, and subarachnoid hemorrhage were verified. One of the following six seasons was associated with the start time: Summer (mid-April to mid-June), Rainy Season (mid-June to mid-August), Autumn (mid-August to mid-October), Late Autumn (mid-October to mid-December), Winter (mid-December to mid-February), and Spring (mid-February to mid-April). Microsoft Office Excel 2013 and SPSS Version 22 were used for statistical analysis.

Results: In summer 31.9% of patients, in winter 20.3% of patients, in rainy (18.1%), in late autumn (15.2%), in autumn (10.1%), and in spring (4.5%) were presented. The overall frequency of ischemic stroke (86.4%), intracerebral hemorrhage (12.7%), and subarachnoid hemorrhagic stroke (1%). The incidence of stroke during summer was significantly greater than that of other seasons. The frequency of intracerebral hemorrhagic stroke during late autumn (3.6%) & winter (3.4%) was greater than that of other seasons. Strokes were more prevalent in males than in females (80.3% vs. 19.7%). The age group of 61 years and older had the greatest rate (41%) of strokes among both males and females.

Conclusions: In comparison to other seasons, the summer had a noticeably greater frequency of ischemic stroke and subarachnoid hemorrhagic stroke. In late fall and winter, there was a higher incidence of intracerebral hemorrhagic stroke compared to prior seasons.

Keywords: *Stroke Occurrence, Stroke Types, Seasonal Variation, Ischemic Stroke, Hemorrhagic Stroke*

1.1 Background

According to Feigin, Lawes, Bennett, Barker-Collo, & Parag's 2009 definition, a stroke is characterized by progressive medical symptoms, such as a change in brain function that lasts for more than a day or symptoms that lead to death solely from vascular causes. It is clear that of all the deaths, the one that resulted from a stroke is thought to be the most well-known. Nonetheless, research has shown that stroke accounts for 85% of all fatalities in both developed and underdeveloped nations (Shaik, Loo, & Gan, 2012). There are a few official health examination services in our nation for these risk factors of non-communicable diseases like stroke that affect people unintentionally. Health is a vital concern that demands careful consideration throughout their physical examination. Stroke is a prevalent, severe, and incapacitating global health issue. It is among the frequent reasons for acquired adult impairment and ranks second or third causes of mortality in other countries (Langhorhorne et al.,2011). "The word stroke used to be possibly first introduced into medicine through William Cole in 1689 in a physico-medical article regarding the late frequencies of apoplexies". Before Cole, apoplexy was the term frequently used to characterize sudden brain injury without trauma injury. According to Alharbi et al., (2019), Hippocrates utilized it for almost 2000 years, beginning around 400 BC.

"Rapidly developing clinical sign of focal/global disturbance of cerebral functions with symptoms lasting for 24 hours or longer or leading to death with no apparent cause different than vascular origin" is how the WHO or World Health Organization describes stroke. A stroke is a localized episode of neurological impairment and injury to brain tissue that lasts longer than twenty-four hours and is caused by either an infarction or hemorrhage. Common forms were hemorrhagic, transitory, and ischemic episodes (Mondal et al., 2022). Approximately 12.7 million strokes have been identified to be caused by triggers, including hypertension. Stroke Statistics 2018 estimates that approximately 15 million individuals globally experience strokes, of which five million people pass away, and the remaining 10 million are completely unable to resume their pre-stroke regular lives. Over half of all people on Earth live in the Asian continent. Due to demographic change and urbanization, stroke rates are predicted to rise in developing Asian nations (Mehndiratta, Khan,

Mehndiratta, & Wasay, 2014). Therefore, stroke incidence may rise in the future (Miah et al., 2012).

Aphasia, right hemiparesis, and left hemianopia are typical indications of a hemisphere on the left stroke; left hemiparesis, left hemianopia, and left hemispatial neglect are typical indicators of a right hemisphere stroke; these symptoms vary based on which part of the brain is damaged. Since 90% of all strokes occur in the supratentorial region, the public can be helped to detect and respond to strokes by using the acronym FAST, which stands for face droop, arm drop, speech disruption, and time. Reduced consciousness and a variety of other symptoms that are typical with posterior circulation or infratentorial stroke include diplopia, bulbar palsies, dysphagia, unilateral dysmetria, and incoordination. Although most strokes are mild, there may be accompanying symptoms including headaches or soreness in the head, face, or neck (Musuka and others, 2015).

Any age can experience a stroke, which can be caused by a decrease in blood supply to the brain. Stroke represents one of the primary reasons behind the increase in disabilities worldwide. A stroke affects a person somewhere on the globe every 0.5 seconds. Worldwide, over 5 million people suffer from strokes each year, rendering them disabled (Rosamond et al., 2008). Changeable and non-changeable are the two types of risk factors for stroke. Risk variables such as race and ethnic background, gender, family history, prior stroke, sex, and TIA (transient ischemic attack) are not changeable by clinical therapy or lifestyle changes. Changes in lifestyle or medical intervention are two ways to address modifiable risk factors. It is separated into Lifestyle Factors and Medical Conditions. Medical issues involve heart conditions such as myocardial infarction & atrial fibrillation, excessive cholesterol, diabetes mellitus, increased blood pressure, and asymptomatic carotid stenosis. Lifestyles include smoking cigarettes, being obese, drinking too much alcohol, and not moving around much (Alharbi et al., 2019). Many factors can affect the outcome of a stroke, such as the kind and severity of the stroke, predisposing factors, related issues, and care facilities (Kumar et al., 2019).

Stroke is the biggest cause of mortality worldwide and disability, and post-stroke therapy is expensive. The Global Burden of Diseases, Injuries, and Risk Factors Study's findings (GBD) cycle 2015 showed that while the overall burden of stroke has remained high, the prevalence and age-standardized stroke death rates have been declining over time. (Johnson et al., 2019). In rural Bangladesh, the primary changeable risk indicator for stroke mortality was elevated blood pressure. Betel consumption may also raise the risk of stroke death, but this may not be widely recognized (Mateen et al., 2012). Cigarette smoking was one of the risk factors for ischemic stroke, anxiety, obesity, diabetes mellitus, and a history of high blood pressure. However, drinking alcohol was linked to an elevated likelihood of hemorrhagic stroke (Donnel et al., 2010). Hypertension is a major risk factor for hemorrhagic stroke (Hannan et al., 2001). The primary risk factors for stroke include diabetes, drinking, smoking cigarettes, and hypertension (Shaik, Loo, & Gan, 2012). Hospital-based research has demonstrated that the main factor for both ischemic and hemorrhagic strokes is hypertension. It has been found to have a marginal impact on Bangladesh's economy because of the handicap it causes (485 per 10,000 persons). Despite the efforts of nonprofit organizations to prevent stroke at the primary level, the incidence has significantly grown in recent decades as a result of a shortage of specialist hospitals and neurologists (Islam et al., 2012). Patients who are aware of the risk factors related to stroke may be able to avoid up to 70% of these cases, according to Miah et al. (2012). Published research indicates that the prevalence of stroke illness increases with age in both men and women, with persons over 75 accounting for 50% of stroke cases and those over 85 for 30%. Studies show that stroke is also a major factor in disability and decreased standards of life (Lui & Nguyen, 2018). The stroke affected 11.39 out of every 1000 people in Bangladesh, with the highest rate in the Mymensingh division (Monda et al., 2022). The stroke affected 0.3% of the population in Bangladesh and killed 25.2% of them (Mateen et al., 2012). Hemorrhagic stroke makes up 37% of all stroke incidence globally, whereas ischemic stroke makes up 63% (Shaik, Loo, & Gan, 2012). However, a significant rate of hemorrhagic stroke has been recorded in Bangladesh (Wasay, Khatri, & Kaul, 2014).

According to published research, 20% of strokes are hemorrhagic and 80% are ischemic. Every year, around Five million of the 20 million people who have a stroke go on to die. Stroke-related deaths are no longer common in the industrialized world. Of all stroke deaths, 85.5% occur in underdeveloped nations. There formerly was a seven-fold difference in the morbidity of stroke between poor and industrialized nations. Stroke is a common reason for emergency hospital admission and is linked to increased mortality, morbidity, and reduced quality of life. The third most prevalent cause of mortality for senior citizens is stroke, behind cancer and coronary artery disease (Kumar et al., 2019).

In Bangladesh, the third most prevalent cause of mortality is stroke., behind heart disease and infectious disorders like influenza and pneumonia. With an age-adjusted death rate of 108.31 per 100,000 persons in 2011, stroke mortality rose from 6.0% in 2006 to 8.57% in 2011. With 2.55% of all disabilities coming from it, it is the seventh most common cause of impairment. Bangladesh ranks 84th in the world for the highest rate of stroke fatalities, the World Health Organization (WHO) claims. In Bangladesh, there are 5·8% untreated deaths per 1000 people; the corresponding ages for males and females are 65·1 and 64·4 years old, respectively (Islam et al., 2013). Bangladesh ranks third in terms of prevalent causes of mortality, with a WHO mortality rate index ranking of 84 (Zaman et al., 2014). Almost 5.7 million individuals worldwide lose their lives to strokes, and 87% of these fatalities occur in low- and middle-income countries (Kumar et al., 2015). In Bangladesh, stroke is the primary reason for death and disability. There are currently few integrated rehabilitation services in Bangladesh's healthcare system. Few governmental and non-governmental groups provide stroke sufferers rehabilitation (Mamin et al.,2017). A stroke results in disabilities, including long-term incapacity that makes walking consistently difficult. Secondary consequences following a stroke include joint rigidity and deformity, heart disease, pressure pain, urinary tract infection (UTI), and lung infection (Eng and Tang, 2007). Primary and secondary education should be given top priority by the Philippine government's preventive initiatives since the prevalence ranges from 1.9 to 6.59% (Loo and Gan, 2013).

Environmental elements including temperature, humidity, and air pressure were the causes of stroke (Cao et al., 2010). Hemoconcentration is caused by a high body temperature that causes excessive fluid loss, which raises the danger of an ischemic stroke (Kvistood et al., 2012). The risk of stroke may be influenced by high yearly rainfall, average temperature, and cold days (Matsumoto et al., 2010). Temperatures both hot and cold were linked to a greater risk of stroke death, with wintertime mortality being higher (Chen et al., 2013). Winter months (December–March) had a higher rate of fatal strokes than summer months (June–September) (Mateen et al., 2012). Summer stroke incident rates were greater than winter rates. Summertime saw an increase in ischemic stroke cases, whereas winter saw an increase in hemorrhagic stroke cases. There was a negative correlation found for stroke hemorrhagic and a positive correlation found in the event of an ischemic stroke (Hannan et al., 2001).

The type of stroke varied by season, with more ischemic strokes in spring and more intracerebral hemorrhages in winter. Ischemic strokes peaked in April, while intracerebral hemorrhages peaked in January. Fall (September to November), spring (March to May), summer (June to August), and winter (December to February) are the four seasons they separated (Kumar et al., 2015). (Iqbal et al., 2015) stated that ischemic stroke affected more than hemorrhagic stroke. Men had more strokes than women. There were monthly differences in stroke rate, with September having the highest and January having the lowest rate. Seasonality varied in stroke. An increased risk of stroke, namely hemorrhagic stroke, has been linked to the winter months. Age group differences were seen in gender, season, and type of stroke. The biggest risk factor was shown to be hypertension.

There were also seasonal differences in stroke rate, with autumn having the highest rate compared to spring (Jin et al., 2018). In the Japanese population, Spring seems to be the season with the highest incidence of stroke. regardless of a person's history of established risk factors (Turin et al., 2008). (Chu et al., 2018) stated that stroke incidence peaked in winter (116862), then rose in spring (113689), summer (113569), and fall (113618). According to Roger et al. (2012), Intracerebral hemorrhage accounts for 10% of all strokes. whereas subarachnoid hemorrhages account for 3% of cases. Eighty-seven percent of strokes are ischemic strokes.

(Fodor et al., 2018) stated that the most frequent type of stroke, according to his study, was an ischemic stroke (89.5%), which was followed by intracerebral hemorrhage (8.7%) and subarachnoid hemorrhage (1.9%). Four distinct seasons were identified by the study: Winter (December to February), fall (September to November), summer (June to August), and spring (March to May). with a second increase in June–August (hot months) and the highest prevalence in December–January (cold season). Intracerebral hemorrhage (ICH) cases were more prevalent in the winter compared to Subarachnoid hemorrhage (SAH) cases, which were more common in the summer.

1.2 Justification of the Study

The World Health Organization's definition of a stroke (WHO) is "rapidly developing clinical sign of focal/global disturbance of cerebral functions with symptoms lasting for 24 hours or longer or leading to death with no apparent cause different than vascular origin." Stroke is a prevalent neurological disorder specified by ischemia or hemorrhagic cerebral vascular flow stoppage and histological alterations in specific brain regions that eventually come about in neuronal death. The afflicted brain regions determine whether there is a behavioral, cognitive, or physical disability (Kumar et al., 2015).

In Bangladesh, the stroke death rate was 25.2% and the stroke prevalence was 0.3%. Winter (December–March) saw a higher number of fatal strokes than summer (June–September) (Mateen et al., 2012). Summer stroke incidence was greater than winter incidence. There were more hemorrhagic strokes. prevalent in the winter, but ischemic strokes were more common in the summer. Hemorrhagic stroke and temperature had a negative correlation, but ischemic stroke and temperature had a positive correlation. One of the primary causes of risk for hemorrhagic stroke is hypertension (Hannan et al., 2001). Another study found that stroke affected 11.39 out of every 1000 people in Bangladesh. Mymensingh division had the most stroke cases (14.71 per 1000) and Rajshahi division had the least (7.62 per 1000) (Monda et al., 2022). There were more ischemic strokes in the spring and more intracerebral hemorrhages in the winter, according to the season. Intracerebral hemorrhages surged in January while ischemic strokes peaked in April. (Kumar et al., 2015). More patients had an ischemic stroke than a hemorrhagic stroke. Strokes were more common in males than in females (Iqbal et al., 2015). While the incidence of stroke was highest in September and lowest in January, the largest incidence of cerebral hemorrhage and ischemic stroke occurred in the fall (Jin et al., 2018). Among Japanese people, the rate of stroke is the highest in spring, no matter what their history of common risk factors is (Turin et al.., 2008). In the United States, the winter months had the greatest frequency of strokes (1166862), followed by the spring (13689), the summer (13569), and the fall (113518). There was an independent relationship between higher results and warmer and more humid weather (Chu et al.,2018). There was no correlation between variations in the weather and the incidence of stroke (Field & Hill, 2002). (Fodor et al., 2018) stated that the most frequent type of stroke, according to his study, was an ischemic stroke (89.5%), which was

followed by intracerebral hemorrhage (8.7%) and subarachnoid hemorrhage (1.9%). The research separated the four seasons into four types: Winter (December to February), fall (September to November), summer (June to August), and spring (March to May). Research also clearly shows that little is known about the types of strokes that occur and how they vary seasonally. Few studies have been found regarding this area. In Bangladesh, only one relevant study has been found in this area. This study aims to determine the seasonal variations and types of stroke occurrence. This research would give valuable information about the identification of the seasonal variations and types of stroke occurrence. Understanding the seasonal variable pattern of stroke incidence may serve as a foundation for cerebrovascular pathology prevention and treatment approaches. This motivated me and that's why the researcher did research regarding this context

1.3 Research Question

What are the seasonal variations and types of stroke occurrence in Bangladesh?

1.4 Study Objective

1.4.1 General Objective

To find out the seasonal variations in stroke occurrence and types of strokes.

1.4.2 Specific Objectives

1. To find out the sociodemographic status of stroke patients.
2. To find out seasonal variations and stroke occurrence in Bangladesh.
3. To find out the association between seasonal variations and stroke occurrence.
4. To find out the association between seasonal variations and the type of strokes.

1.5 Operational Definition

Stroke

"Rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin," is how the World Health Organization (WHO) defines a stroke. A stroke is a localized episode of neurological impairment and brain tissue damage that lasts longer than twenty-four hours and is caused by either an infarction or hemorrhage. Common forms were hemorrhagic, transitory, and ischemic episodes (Monda et al., 2022).

Ischemic Stroke

A period of localized neurological dysfunction associated with a cerebral, spinal, or retinal infarction is referred to as an ischemic stroke (Sacco et al., 2013).

Intracerebral Hemorrhage

Intracerebral hemorrhage is defined as a localized hematoma that is not related to trauma that takes place in the ventricular system or brain parenchyma (Sacco et al., 2013).

Subarachnoid Hemorrhage

Bleeding into the subarachnoid region, which is where the arachnoid membrane and pia mater of the brain or spinal cord meet, is referred to as a subarachnoid hemorrhage (Sacco et al., 2013).

Season

The climate type is related to a certain period of year and season, wherever it occurs. The primary reason for the seasonal changes is the tilt of the earth's axis concerning the sun's location at any given time (Banglapedia, National Encyclopedia of Bangladesh).

Seasonal variation

Variations in a time series that happen more or less consistently during the course of a year are referred to as seasonal variations (Banglapedia, National Encyclopedia of Bangladesh).

Summer

The summer months of **mid-April to mid-June** are the hottest of the year (Banglapedia, National Encyclopedia of Bangladesh).

Rainy Season

The majority of a region's yearly average rainfall occurs during the rainy season, also known as the wet season or the monsoon season **(mid-June to mid-August)** (Banglapedia, National Encyclopedia of Bangladesh).

Autumn

The period that comes after summer but before winter is between **mid-August to mid-October** (Banglapedia, National Encyclopedia of Bangladesh).

Late Autumn

The final stages of fall are just before winter arrives between **mid-October to mid-December** (Banglapedia, National Encyclopedia of Bangladesh).

Winter

The year's coldest season is winter between **mid-December to mid-February** (Banglapedia, National Encyclopedia of Bangladesh).

Spring

Spring is the season that follows winter **(mid-February to mid-April)** and before summer (Banglapedia, National Encyclopedia of Bangladesh).

1.6 Conceptual Framework

Independent Variable	Dependent Variable

Sociodemographic Information
- Age
- Gender
- Living Area
- Division

Season-related variables
- Seasons
  - ✓ Summer
  - ✓ Rainy Season
  - ✓ Autumn
  - ✓ Late Autumn
  - ✓ Winter
  - ✓ Spring
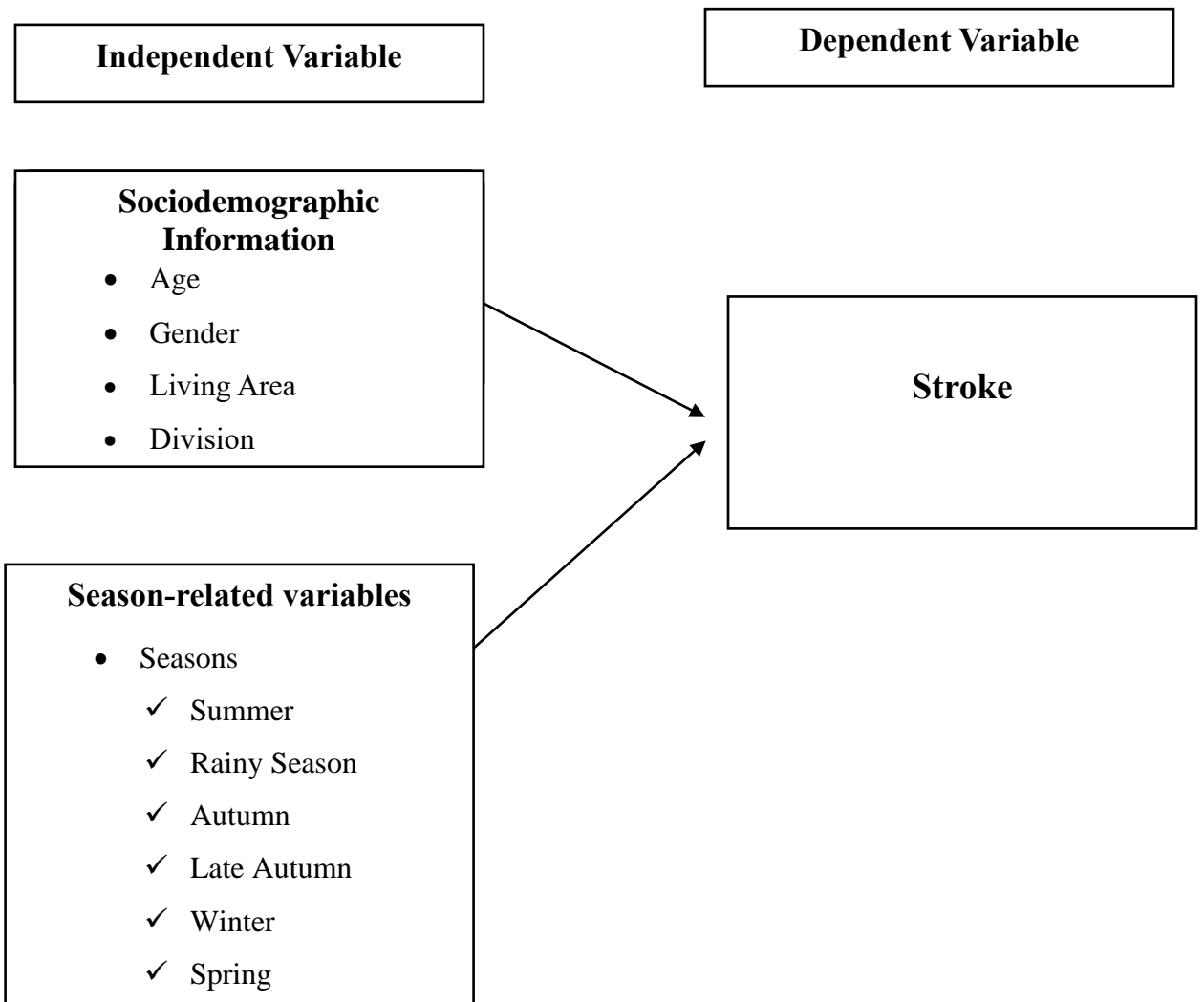
Stroke

1.7 Outline of the Thesis

The upcoming thesis chapter is outlined as follows. Chapter II includes literature reviews of Bangladesh as well as other countries. It includes information about stroke including stroke prevalence, seasonal variations of stroke incidence, and risk factors. It also gives insight into the literature which has performed similar studies in the past. Chapter III provides information about the research methodology that was followed in conducting this research. It displays the methods that were applied to the study design, study area, sample size, data collection period, measurement tools, sampling techniques, data collection methods/procedures, inclusion & exclusion criteria, data management & analysis, quality control & quality assurance, and ethical considerations. Chapter IV displays the outcomes of this study named Identification of the Seasonal Variations and Types of Stroke Occurrence. This chapter also presents the relationship and differences between variables. The information on how the outcomes of this study concur or differ from those of other researchers is highlighted in Chapter V. Chapter VI provides the conclusion of the study, and Chapter VII provides the limitations & recommendations of the study. Likewise, it also provides recommendations for future research.

The title's keywords and the related field of interest were used to perform a thorough literature study. The information was sourced from Google Scholar, PubMed, and BHPI Library. The material was compiled from a variety of academic and general science publications published between 2010 and 2024. Here are the review's findings:

The research on the global burden of disease (GBD) for 2017 states that 11.9 million people new stroke cases worldwide in 2017 compared to 6.8 million in 1990, a 76% increase. Age-standardized stroke prevalence grew by 3% globally between 1990 and 2017, with the majority of the increase occurring in UMICs (Upper Middle-Income Countries), at 1300.6 per 100,000. On the other hand, in Lower-Income Countries (LICs) and Higher-Income Countries (HICs), the age-standardized rates of prevalent stroke cases had declined by 3% and 8%, respectively, by 2017. Interestingly, compared to ischemic strokes, the age-standardized incidence of hemorrhagic strokes declined dramatically globally between 1990 and 2017 (Avan et al., 2019). According to Wasay, Khatri, and Kaul (2014), The global rate of stroke death is greatest in South Asia, accounting for 40% of all stroke-related deaths. In Bangladesh, there are 500–2000 strokes per million people, compared to 44–843 strokes per million people in India. Sri Lanka's estimated prevalence is 1000/100,000, compared to Pakistan's prevalence of 218/100,000 (Prasad, Vibha, & Meenakshi, 2012).

Nepal is the only South Asian nation without any known statistics on the prevalence of stroke (Prasad, Vibha, & Meenakshi, 2012). However, according to the Jaya Stroke Foundation in Nepal, 15,000 people die from strokes each year and 50,000 people suffer from them on average (Pandit et al., 2006). With 162,000,000 people, Bangladesh is a developing nation and is regarded as having a low standard of living. Stroke is a well-known cause of mortality and the third most common cause of death in Bangladesh. In comparison to Southeast Asia, the death rate increased dramatically between 2006 and 2011, from 6% to 8.57% (Basri et al., 2013; Islam et al., 2012). Based on studies conducted in 2013, the World Health Organization (WHO) estimates that 15,000,000 people worldwide suffer from stroke annually. Every year, 795,000 Americans in the United States of America (USA) have a stroke. those who have either had a single stroke or several strokes (International Stroke Center, 2014). There is a higher prevalence of stroke in men due to their smoking habits and the estrogen hormones' protective effects against ischemic

stroke (Basri et al. (2013). Stroke rates are estimated to be greater in underdeveloped nations than in wealthy nations. The estimated rate of stroke in persons in South Asian nations is 47–417 per 100,000 (Kulshreshtha et al., 2012).

Another population-based cross-sectional study was conducted in Bangladesh titled "Prevalence and risk factors of stroke in Bangladesh" The study found that the age range was 18 to 113 years old. The respondents were 39.97 ± 14.03 years old on average. The study team conducted interviews with 25,287 respondents in total. 7577, or one-third, of the responders were from the Dhaka division. The lowest percentage of responders were from Sylhet (1767, 7%), Barisal (1268, 5%), Mymensingh division (1020, 4%), Rajshahi (3282, 13%), Rangpur (2789, 11%), Khulna (2783, 11%), Chittagong (4801, 19%), and Barisal (1268, 5%). They discovered that 11.39 strokes per 1000 people lived in Bangladesh. Rajshahi division had the lowest frequency (7.62 per 1000), while the Mymensingh division had the highest prevalence (14.71 per 1000). The prevalence of stroke varied by geographical region, age group, gender, and rural/urban areas. Different age groups have varying rates of stroke prevalence. It was 30.10 per thousand in the over-60 age group and 4.60 in the under-40 age group. Male stroke prevalence was double that of female prevalence (13.62 against 8.68 per thousand). In rural regions, the frequency was somewhat higher (11.85 versus 11.07). Ischemic stroke accounted for 79.7% of all stroke cases (213), with hemorrhagic stroke coming in second at 15.7% (42), and subarachnoid hemorrhage at 4.6% (12). The total hemorrhagic stroke was 20.3% (n=54). According to the study, 59.4% of participants were under 40, followed by 19.6% in the 41–50 age range, 12.3% in the 51–60 age range, and 8.7% in the >60 age range. The range of ages was eighteen to One hundred thirteen. 58.9% (14904) of the total responses were from metropolitan areas, while 41.1% were from rural ones. The use of tobacco (37.2%), diabetes (28.8%), dyslipidemia (38.9%), hypertension (79.2%), and ischemic heart disease (20.1%) were the most frequent risk factors for stroke. 50.4% of the respondents were somewhat aware of stroke. The prevalence was significantly higher in the male and older populations. An ischemic stroke affected about three-quarters of them (Mondal et al., 2022).

Another study was conducted in 2012 in Bangladesh named "A population-based case-control study of 1250 stroke deaths in rural Bangladesh." They discovered that stroke

mortality was 25.2% and stroke frequency was 0.3% in Bangladesh. Additionally, they discovered that winter (December–March) had a higher rate of fatal strokes than summer (June–September). Diabetes and hypertension significantly increase the chance of stroke death. Chewing betel may increase the chance of stroke mortality, although this isn't well recognized (Mateen et al., 2012).

Another study was conducted in Bangladesh titled Stroke: "Seasonal Variation and Association with Hypertension." According to the study, summertime stroke incidence was greater than wintertime incidence. The patients had a mean age of 56.18±12.86 years, and they ranged in age from 25 to 90. The majority of patients (76.1%) were in the age range of 41 to 70. 111 (71.6%) males and 44 (28.4%) females were present. For every female, there were 2.53 men. There were 155 total subjects, including 121 and 34 in the summer and winter, respectively. Of the 121 individuals, 34 (28.1%) experienced a hemorrhagic stroke, of which 32 had an intracerebral hemorrhage (ICH) and 2 had a subarachnoid hemorrhage (SAH). Of the 121 participants, 87 (71.9%) had an ischemic stroke over the summer. In a total of 34 individuals, there were 18 (52.9%) ischemic strokes and 16 (47.06%) hemorrhagic strokes (all ICH) throughout the winter. Total ischemic stroke was 67.7% (105), Intracerebral hemorrhage 31% (48), and subarachnoid hemorrhage 1.3% (02). The total hemorrhagic stroke was 42.3% (50). Summertime had a markedly higher prevalence of ischemic strokes than winter did. Winter was a considerably more common season for hemorrhagic stroke cases than summer ones. Temperature was found to have a negative link with hemorrhagic stroke and a positive correlation with ischemic stroke. Hemorrhagic stroke was statistically significantly more correlated with hypertension than ischemic stroke, regardless of the season (Hannan et al., 2001).

The name "land of six seasons" refers to Bangladesh. Summer: From mid-April to mid-June are the warmest months of the year. Rainy Season: Also referred to as the wet season or the monsoon season, the rainy season covers most of a region's annual average rainfall (mid-June to mid-August). Autumn: Mid-August to mid-October is the season that follows summer but before winter. Late Autumn: From mid-October to mid-December is when fall comes to an end and winter begins. Winter: From mid-December to mid-February, the winter season is the coldest of the year. Spring: The season that comes after winter (mid-

February to mid-April) but before summer is known as spring (Banglapedia, National Encyclopedia of Bangladesh).

Another study was conducted named "Seasonal Variations in Stroke: A Study in a Hospital in North India." They classified the seasons into four groups: winter (December to February), autumn (September to November), summer (June to August), and spring (March to May). 769 (69.9%) of the 1,099 stroke patients were male. Its average age (± SD) was 53.8 (± 15.7) years. 436 patients (39.7%) had ICH and 663 patients (60.3%) had IS overall. The seasons with the highest prevalence of IS were spring (n = 223, 33.6%), winter (n = 168, 25.3%), summer (n = 166, 25%), and autumn (n = 106, 16%). Winter (n = 165, 37.8%), spring (n = 116, 26.6%), autumn (n = 81, 18.6%), and summer (n = 74, 17%) were the seasons with the highest frequency of ICH. January had the highest frequency of ICH, whereas April had the highest incidence of IS. The study found that there were significant seasonal variations in the happening of ischemic stroke (IS) & intracerebral hemorrhage (ICH), with ischemic stroke (IS) being more common in spring and intracerebral hemorrhage being more common in winter (Kumar et al., 2015).

Another research, titled "SEASONAL VARIATION IN STROKE," was carried out from January 1 to December 31, 2014, at the medical department of the MTI Lady Reading Hospital in Peshawar, Khyber Pakhtunkhwa, Pakistan. The research aimed to determine whether the incidence of stroke and its subtypes, hemorrhagic stroke and ischemic stroke, varied seasonally in the summer and winter. They divided the seasons into two categories: summer (April, May, June, July, August, and September) and winter (October, November, December, January, February, and March). The total case was 321. The age group that had the highest number of strokes in men was 60–69; in women, it was 50–59; during the winter, there was a rise in strokes in all age groups; among patients in the 60–69 age group, the proportion of ischemic stroke patients was lower than that of hemorrhagic stroke patients. In two distinct seasons, patients were seen: 41.48% (133) in the summer and 58.56% (188) in the winter. 33.95% (109) suffered a hemorrhagic stroke and 66.04% (212) experienced an ischemic stroke. Strokes were more common in men than in women (60.75% vs. 39.25%) (195 vs. 126). The age categories with the largest number of strokes in males were 60–69, whereas the age groups with the highest number in females were 50–59. The stroke risk factor with the greatest percentage was hypertension (34.26%).

December (28) was the month with the highest frequency of hemorrhagic strokes, followed by August and November (10), in that order. April was the month with the fewest hemorrhagic strokes (04) The month of January saw the greatest number of ischemic strokes, while April saw the fewest (06) (Iqbal et al., 2015).

Another research, named "Seasonal variation of stroke incidence," was carried out in Wujin, a city in southeast China, between January 2006 and December 2007. They separated the seasons into four groups: winter, autumn, summer, and spring. There were 2319 stroke patients during the course of the two-year research (1217 male cases and 1102 female cases). The average age of stroke patients was 68.1 ± 12.3. There were 1562 (67.4%) stroke patients between the ages of 20 and 64 at the time the stroke began. 757 (32.6%) stroke patients were 65 years of age or older at the time the stroke started. Every year, September had the greatest rate of strokes per 100,000 persons, while January had the lowest rate. People 65 years of age or older and those between the ages of 20 and 64 had the highest risk of stroke occurrence in September. The highest frequency of ischemic stroke occurred in September. The incidence of stroke peaked in the spring. Fall was the greatest season for stroke incidence (Jin et al.,2018).

Japanese research titled "Higher Stroke Incidence in the Spring Season Regardless of Conventional Risk Factors" was carried out. September, October, and November is autumn; December, January, and February is winter; March, April, and May is spring; and June, July, and August is summer. are the four seasons. 1665 stroke cases (of which 893 were in males and 772 in females) were documented during the 1988–2001 study period. At the time of the stroke, the mean age of the patients who were registered was 74.2 years for females and 69.4 years for males. Brain infarction (1131; men, 654; women, 486) and cerebral hemorrhage (352; men, 171; women, 181) were the two most common categories. Thirty (1.8%) stroke patients have experienced a myocardial infarction before. The spring had the highest incidence of stroke (231.3 per 100,000 person-years; 95% CI: 211.1 to 251.5), whereas the summer had the lowest incidence (183.1; 95% CI: 165.2 to 201.1). The springtime stroke incidence was greater in males (240.8; 95% CI, 211.5 to 270.2) and women (222.1; 95% CI, 194.4 to 249.9), as well as in persons who were younger (72.6; 95% CI, 60.0 to 85.3) and older (875.9; 95% CI, 787.5 to 964.3) (Turin et al., 2008).

The research "Temperature and Precipitation Associate with Ischemic Stroke Outcomes" was carried out in the United States. There are four different sorts of seasons: winter (January, February, March, and May in the spring, June, July, and August in the summer, and September, October, and November in the autumn/fall). The results were that winter had a higher incidence of strokes (116862), followed by spring (113689), summer (13569), and fall (113618). Winter was a more prevalent time for ischemic stroke admissions. Better results were independently correlated with warmer and wetter weather (Chu et al., 2018).

Another study was conducted in Finland titled "Seasonality of Stroke", It was discovered that the seasons differ in terms of the frequency of the major stroke subtypes (ischemic stroke, subarachnoid hemorrhage, and intracerebral hemorrhage), with autumn having the greatest incidence and summer having the lowest. Different types of strokes appear to have different hospital stay lengths and seasonal patterns in in-hospital mortality. The monthly mortality rate was greatest in June and lowest in October (Jussi et al., 2017).

Another study was conducted in Japan titled "Seasonal Variations in Neurological Severity and Outcomes of Ischemic Stroke". The study discovered that winter was a more prevalent season for cardioembolic stroke. Patients with ischemic stroke experienced more moderate to severe first neurological impairments in the winter and spring, and the condition was not more prevalent in the winter (Toyoda et al.,2018). A sample size of 4038 strokes was observed using data from the Kaunas, Lithuania stroke registry between 2000 and 2010; ischemic stroke accounted for 80.4% of occurrences, whereas hemorrhagic stroke accounted for 19.6%. On the other hand, women were more likely to experience hemorrhagic stroke in response to low temperatures, but high wind speed was associated with a higher incidence of ischemic stroke (Tamasauskiene et al., 2017). There was no correlation between variations in the weather and the incidence of stroke (Field & Hill, 2002).

Another study was conducted in Romania named "Seasonal variation of stroke occurrence: a hospital-based study". Men make up 47.18% (572) of the 1083 cases, while women make up 52.81% (511). Of the 1083 patients, 969 patients had IS (89.47%), 94 had ICH (8.68%), and 20 had SAH. These patients were divided into the three types of stroke that are currently recognized. The winter months of December and January have the greatest incidence of ischemic stroke. The autumnal months of September through October have

the lowest incidence of ischemic stroke. While SAH had its highest frequency during the summer, ICH had its highest incidence throughout the winter. Four seasons were identified by the study: spring (March to May), summer (June to August), fall (September to November), and winter (December to February) (Fodor et al., 2018).

Another study was conducted named "Seasonal variation in the occurrence of stroke in Northern Greece: a 10-year study in 8204 patients" to ascertain whether the frequency of stroke in Northern Greece varies with the seasons. The year's months were divided into four seasons: autumn (September, October, and November), winter (December, January, and February), spring (March, April, and May), and summer (June, July, and August). Over the course of the 10-year research, 8204 strokes were documented, 4801 of which involved women and 3403 involved men. The corresponding percentages for IS, ICH, TIA, and SAH were 78.8, 11.1, 6.6, and 3.5%. The highest rates of stroke incidence were observed in the winter and spring, with summertime having the lowest rates. The study discovered a considerable seasonal fluctuation in men, with spring marking the greatest occurrence and summer marking the lowest. We also observed a strong seasonal fluctuation in women, with spring marking the greatest incidence and autumn marking the lowest (Karagiannis et al., 2010).

CHAPTER-III	METHODOLOGY

3.1 Introduction

Research methodology is the method that is used to collect data from the population to solve a problem. Research methodology is the procedure in which the researcher identifies, selects, processes, and analyzes information about a specific topic. It mainly answers the questions of how the data will be collected and how it will be analyzed. It also gives a clear idea of when, what, and how the study will be conducted, data will be analyzed and represented. Since it allows the reader to evaluate the reliability and validity of the study, the research methodology should include what type of research was conducted, how the data was conducted, how it will be represented, which tool or method was used, and why particular methods were used. There are two kinds of data that may be acquired: qualitative and quantitative data. Qualitative data are descriptive in nature, based on language or images, whereas quantitative data are represented by numbers and statistical procedures. Deep interviews are used in these studies, which increase sample size take longer to complete, and reduce the likelihood of extrapolating findings to a larger population. Face-to-face interactions between researchers and interviewers yield quantitative data, which is subjective and interpretative in nature. Conversely, the quantitative approach concentrates on gathering data that is objectively collected and involves a large number of individuals. Quantitative data seems more scientific and is appropriate for answering informal queries since it describes statistics and statistical reports that make the analytical process much more precise and simpler. Furthermore, these data kinds are useful for extrapolating the results to a larger population since they may be included in several populations and are simply evaluated by software (such as Excel and SPSS). In order to gather information for this study and get the intended results, researchers employed quantitative data-gathering techniques. The methods for carrying out the study are covered in this chapter. The study design that was employed is shown in Section 3.2. The study population is highlighted in Section 3.3 of the document. The research area/site, sample size, data collecting time, and measuring instruments are all described in Sections 3.4, 3.5, 3.6, and 3.7, in that order. Section 3.8 presents the study's sampling strategy. The study's data gathering method and materials are described in Section 3.9. Section 3.10 explains the inclusion and exclusion

criteria. This chapter concludes with Section 3.12 outlining the study's ethical issues and Section 3.11 outlining the data management and analytic methods.

3.2 Study Design

The research design used in this study was cross-sectional., gathering data from the sample and analyzing it at a specific point in time that measured the seasonal variations and types of stroke occurrence. This study was based on measuring seasonal variations and types of stroke occurrence. A cross-sectional study design allows a researcher to gather data at one time from a large number of diverse participants. Quantitative data of various variables and relationships among them can be obtained through this method.

3.3 Study Population

Stroke patients included in this research were receiving treatment from the indoor Neurology & Stroke rehabilitation unit and the Medicine unit from Shaheed Suhrawardy Medical College & Hospital.

3.4 Study Area

The samples were gathered from the indoor Neurology & Stroke rehabilitation unit and the Medicine unit at Shaheed Suhrawardy Medical College & Hospital. It is one of the renowned government hospitals for the tertiary degree in Dhaka, Bangladesh that is working for the betterment and growth of healthcare professionals in Bangladesh, they provide both indoor & outpatient department services.

3.5 Sample Size

The sample size calculation equation is provided below.

$$n = Z^2 * p * q / d^2$$

Here,

n=Sample size

Z=The standard normal deviation which is 1.96

P (Prevalence) = 0.3 (Mateen et al., 2012).

q = (1- p)

= (1- 0.3)

= 0.7

So, $n = Z^2 * p * q / d^2$

$$= (1.96 * 1.96) * 0.3 * 0.7 / (0.05 * 0.05)$$

$$= 322.7 = 323$$

Secondary data were used in this study and this secondary data was collected from medical records of the Neurology & Stroke rehabilitation unit and the Medicine unit of Shaheed Suhrawardy Medical College's admission book dated from April 2023 to March 2024 to identify the seasonal variations and types of stroke occurrence. The sample size of the study was 1051 in number.

3.6 Data Collection Period

The data collection period was two (02) months from February 2024 to March 2024. This time data was collected from medical records of the Neurology & Stroke rehabilitation unit and the Medicine unit of Shaheed Suhrawardy Medical College's admission book dated from April 2023 to March 2024.

3.7 Measurement Tools

A self-structured questionnaire was used to measure sociodemographic and season-related variables.

3.8 Sampling Technique

A purposive sampling technique was chosen in this study. Using purposive selection, the researcher chose a sample of 1051 stroke patients for the research. One method of non-random sampling is purposeful sampling. Random sampling was not as suitable as purposeful sampling. Purposive sampling was employed by the researcher to obtain more precise data from individuals.

3.9 Data Collection Methods/Procedures

The researcher started data collection after obtaining approval from the Shaheed Suhrawardy Medical College & Hospital. The study approval was granted and reviewed by the Institutional Review Board review (IRB) of Bangladesh Health Professions Institute (BHPI) and Dhaka University. Then the researcher went to the Neurology & Stroke rehabilitation unit and the Medicine unit's Nurses' station at Shaheed Suhrawardy Medical College & Hospital. Authority allowed for collecting secondary data from medical records of the Neurology & Stroke rehabilitation unit and the Medicine unit of Shaheed Suhrawardy Medical College's admission book dated from April 2023 to March 2024 to identify the seasonal variations and types of stroke occurrence. The researcher took snapshots from admission books from the mentioned unit dated from April 2023 to March 2024. The total sample was 1051 in number.

3.10 Inclusion & Exclusion Criteria

3.10.1 Inclusion Criteria

Stroke patients who were admitted to Shaheed Suhrawardy Medical College and Neolocal Ward.

3.10.2 Exclusion Criteria

Neurology OPD patients of Shaheed Suhrawardy Medical College.

3.11 Data Management & Analysis

Each response was double-checked once the first data collection was finished in order to identify any missing or ambiguous information. Microsoft Office Excel 2013 and the Statistical Package of Social Science (SPSS) Version 22 were used to evaluate all of the data after they had been entered into the program. Data were displayed using tables, bars, and pie charts after being subjected to descriptive statistical analysis. Data were presented using pie charts, bars, and columns in Microsoft Word and Excel. The goals of the research were met by using descriptive statistics.

3.12 Quality Control and Quality Assurance

The researcher asked the supervisor for assistance as needed in order to carry out the study. Biases, values, or personal opinions of the researcher are not taken into account while analyzing secondary data. The whole duration of the study project saw the meticulous collection of data and the preservation of recipient anonymity. To preserve the correctness of the data entry in the SPSS files, the researcher double-checked all of the data. Displaying any personal interpretation has no bearing on the result's conclusion.

3.13 Ethical Consideration

The World Health Organization (WHO) and the Bangladesh Medical Research Council (BMRC) research criteria were adhered to during the whole process of this study. The Institutional Review Board (IRB) approved the methodology-focused dissertation proposal, and the Bangladesh Health Professions Institute's (BHPI) appropriate ethics committee official also approved it. Moreover, Prior to starting data collecting, the researcher received approval from the Director of Shaheed Suhrawardy Medical College & Hospital and the respondents. The researcher has rigorously upheld confidentiality and will never divulge to third parties any personal information about the condition or provided data of the subject.

CHAPTER-IV	RESULT

4.1 Introduction

This section provides an overview of the study's findings. Based on the goals of the study, the findings are displayed. Tables and figures appropriately display the gathered findings. Section 4.2 shows the result of the socio-demographic variables (Age, Gender, and Living Area). 4.3 Results for the division. Figure 01 displays the distribution of the study subjects by the incidence season. Figure 02 displays the distribution of the study subjects by diagnosis of the respondents 4.4 Results for the Incidence Diagnosis of the Respondents, 4.5 Results for the association between incidence season and group age of the respondents, 4.6 Results for the association between incidence season and diagnosis of the respondents, 4.7 Results for the association between incidence season and division, and 4.8 Results for the association between division and diagnosis of the respondents

4.2 Results for the Socio-Demographic Status

Table 01: Distribution of the study subjects by age, gender, and living area of the participants

Socio-demographic characteristics of the participants	n=1051	
Age in Years	**Frequency (n)**	**Percent (%)**
40 years and below	109	10.4
41-50 years	224	21.3
51-60 years	287	27.3
61 years and above	431	41.0
Mean±SD	**58.838±13.393**	
Gender		
Female	207	19.7
Male	844	80.3
Living Area		
Urban	723	68.8
Rural	328	31.2

Table 01 provides demographic insights into the respondents: it reveals that the majority of respondents fall within the age groups of ≤40 years 10.4% (109), 41-50 years 21.3% (224), 51-60 years 27.3% (287), and ≥61 years 41% (431), with an average age of 58.8382±13.39369 years. Additionally, the table indicates a gender distribution where males comprise the vast majority at 80.3% (844), while females make up 19.7% (207) of the total. Furthermore, it compares respondents' living areas, with 68.8% (723) residing in urban areas, and 31.2% (328) residing in urban areas.

4.3 Results for the Division

Table 02: Distribution of the study subjects by division of the respondents (n=1051)

Division	Frequency	Percent
Dhaka	689	65.6
Chattogram	179	17.0
Barisal	75	7.1
Khulna	36	3.4
Mymensingh	27	2.6
Sylhet	6	0.6
Rajshahi	23	2.2
Rangpur	16	1.5
Total	**1051**	**100.0**

Table 02 presents the divisional distribution of respondents, indicating that the Dhaka division has the highest frequency at 65.6% (689), while the lowest frequency is observed in the Sylhet division, accounting for only 0.6% (06).
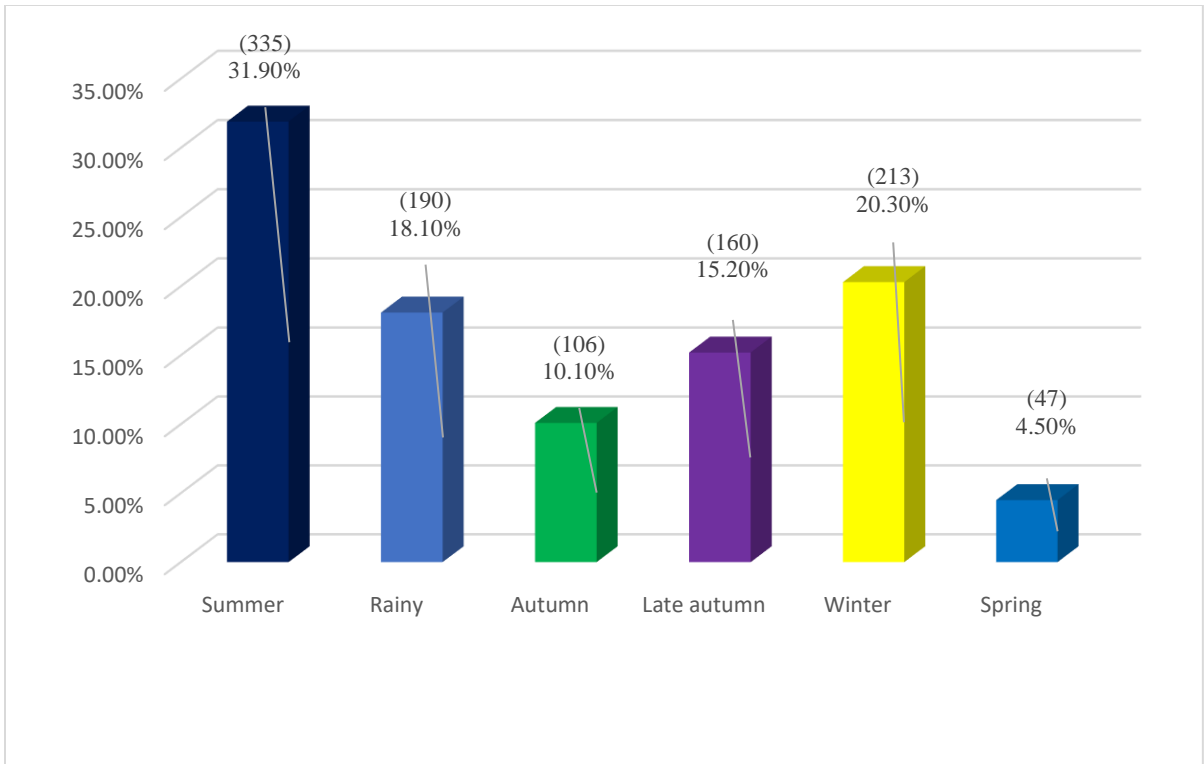
Figure 01: Distribution of the study subjects by the incidence season (n=1051)

Figure 01 categorizes incidents by season, showing that summer has the highest incidence rate at 31.9% (335) and spring has the lowest incidence rate at 4.50% (47).
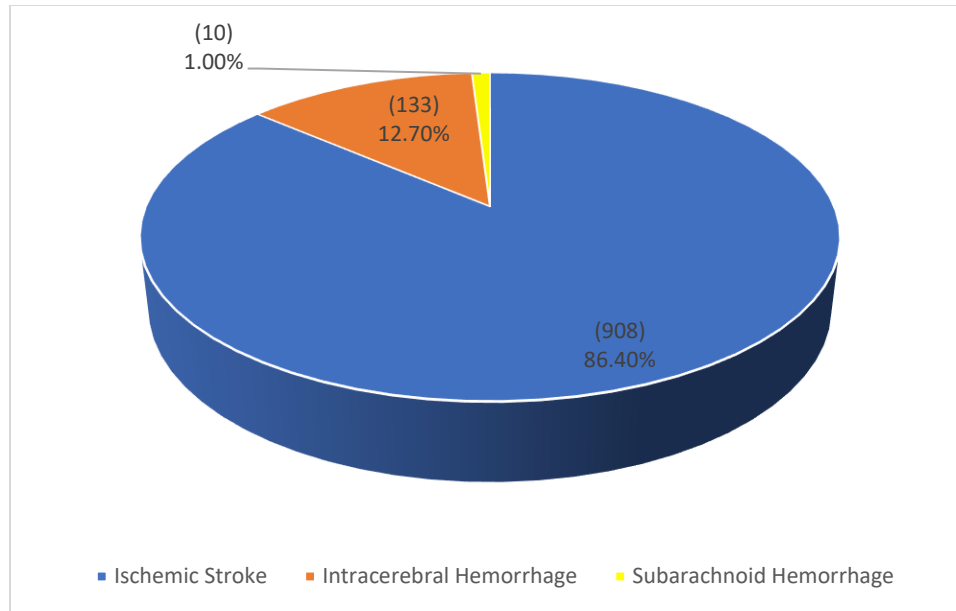
Figure 02: Distribution of the study subjects by Diagnosis of the respondents (n=1051)

Figure 02 shows that the most prevalent diagnosis is ischemic stroke with 908 respondents or 86.4% of cases. The second most frequent condition is intracerebral hemorrhage, representing **12.7%** with **133** respondents affected and the least common among the diagnoses is Subarachnoid Hemorrhage, comprising **0.9%** with **10** respondents.

4.4 Results for the association between Incidence Month and Gender of the Participants

Table 03: Study participants' distribution according to the relationship between the respondents' gender and the incidence month.

Incidence Month	Gender of the Respondents		Total	x^2	p-Value
	Female	Male			
January	0(0%)	126(12%)	126(12%)	98.969	0.000
February	3(0.3%)	96(9.1%)	99(9.4%)		
March	0	0	0		
April	12(1.1%)	27(2.6%)	39(3.7%)		
May	35(3.3%)	166(15.8%)	201(19.1%)		
June	32(3%)	122(11.6%)	154(14.7%)		
July	37(3.5%)	57(5.4%)	94(8.9%)		
August	26(2.5%)	38(3.6%)	64(6.1%)		
September	20(1.9%)	47(4.5%)	67(6.4%)		
October	2(0.2%)	19(1.8%)	21(2%)		
November	24(2.3%)	85(8.1%)	109(10.4%)		
December	16(1.5%)	61(5.8%)	77(7.3%)		
Total	207(19.7%)	844(80.3%)	1051(100%)		

The P-value attained from the Pearson Chi-square (x^2) test, results were tabulated as number (%) and the significant level was $p<0.05$.

Table 03 shows that the p-value was less than 0.05, at 0.000. There was a statistically significant correlation between Incidence Month and Gender of the Respondents.

4.5 Results for the association between Incidence Season and Group age of the participants

Table 04: Study participants' distribution according to the relationship between the respondents' age group and the incidence season.

Incidence Season	Group age of the Respondents				Total	x^2	p-Value
	40 years and below	41 to 50 Years	51 to 60 Years	61 years and up			
Summer	42(4%)	71(6.8%)	101(9.6%)	121(11.5%)	335(31.9%)	25.214	0.047
Rainy	26(2.5%)	47(4.5%)	50(4.8%)	67(6.4%)	190(18.1%)		
Autumn	10(1%)	24(2.3%)	29(2.8%)	43(4.1%)	106(10.1%)		
Late Autumn	13(1.2%)	39(3.7%)	39(3.7%)	69(6.6%)	160(15.2%)		
Winter	15(1.4%)	38(3.6%)	57(5.4%)	103(9.8%)	213(20.3%)		
Spring	3(0.3%)	5(0.5%)	11(1%)	28(2.7%)	47(4.5%)		
Total	109(10.4%)	224(21.3%)	287(27.3%)	431(41%)	1051(100%)		

The P-value was gathered from the Pearson Chi-square (x^2) test, results were tabulated as number (%) and the significant level was $p < 0.05$.

The p-value was 0.047, which was less than 0.05, as table 04 displays. The Incidence Season and the Respondents' Group age showed a statistically significant correlation.

4.6 Results for the Association between Incidence Season and Diagnosis of the Participants

Table 05: Study subject distribution according to the relationship between the respondents' diagnoses and the incidence season

Incidence Season	Diagnosis of the Respondents			Total	x²	p-Value
	Ischemic Stroke	Intracerebral Hemorrhage	Subarachnoid Hemorrhage			
Summer	309(29.4%)	19(1.8%)	7(0.7%)	335(31.9%)	84.826	0.000
Rainy	185(17.6%)	4(0.4%)	1(0.1%)	190(18.1%)		
Autumn	85(8.1%)	20(1.9%)	1(0.1%)	106(10.1%)		
Late Autumn	122(11.6%)	38(3.6%)	0(0.0%)	160(15.2%)		
Winter	176(16.7%)	36(3.4%)	1(0.1%)	213(20.3%)		
Spring	31(2.9%)	16(1.5%)	0(0.0%)	47(4.5%)		
Total	908(86.4%)	133(12.7%)	10(1%)	1051(100%)		

The P-value attained from the x2 test of the Pearson Chi-square, results were tabulated as number (%) and the significant level was $p < 0.05$.

Table 05 the p-value was 0.000, which was less than 0.05, as can be seen. A statistically significant correlation was observed between the respondents' diagnosis and the incidence season.

4.7 Results for the Association between Incidence Season and Division

Table 06: Distribution of the study subjects by association between Incidence Season and Division

Incidence Season	Division								Total	x²	p-Value
	Dhaka	Chittagong	Barisal	Khulna	Mymensingh	Sylhet	Rajshahi	Rangpur			
Summer	225 (21.4%)	52 (4.9%)	23 (2.2%)	14 (1.3%)	10 (1%)	1 (0.1%)	7 (0.7%)	3 (0.3%)	335 (31.9%)	39.182	0.288
Rainy	128 (12.2%)	30(2.9%)	13 (1.2%)	7 (0.7%)	2 (0.2%)	1 (0.1%)	7 (0.7%)	2 (0.2%)	190 (18.1%)		
Autumn	76 (7.2%)	18 (1.7%)	8 (0.8%)	1 (0.1%)	1 (0.1%)	0 (0.0%)	1 (0.1%)	1 (0.1%)	106 (10.1%)		
Late Autumn	110 (10.5%)	23 (2.2%)	12 (1.1%)	3 (0.3%)	4 (0.4%)	2 (0.2%)	4 (0.4%)	2 (0.2%)	160 (15.2%)		
Winter	124 (11.8%)	43 (4.1%)	16 (1.5%)	8 (0.8%)	10 (1%)	1 (0.1%)	3 (0.3%)	8 (0.8%)	213 (20.3%)		
Spring	26 (2.5%)	13 (1.2%)	3 (0.3%)	3 (0.3%)	0(0.0%)	1 (0.1%)	1(0.1%)	0(0.0%)	47 (4.5%)		
Total	689 (65.6%)	179 (17%)	75 (7.1%)	36 (3.4%)	27 (2.6%)	6 (0.6%)	23 (2.2%)	16 (1.5%)	1051 (100%)		

The P-value attained from the x2 test of the Pearson Chi-square, results were tabulated as number (%) and the significant level was p<0.05.

Table 06 demonstrates that the p-value was 0.288, over the 0.05 cutoff. The relationship between Division and Incidence Season was statistically non-significant.

4.8 Results for the Association between Division and Diagnosis of the Respondents

Table 07: The study participants were distributed based on the correlation between the respondents' diagnosis and division.

Division	Diagnosis of the Respondents			Total	x^2	p-Value
	Ischemic Stroke	Intracerebral Hemorrhage	Subarachnoid Hemorrhage			
Dhaka	598(56.9%)	84(8%)	7(0.7%)	689(65.6%)	5.270	0.982
Chittagong	152(14.5%)	26(2.5%)	1(0.1%)	179(17%)		
Barisal	65(6.2%)	9(0.9%)	1(0.1%)	75(7.1%)		
Khulna	32(3%)	4(0.4%)	0(0.0%)	36(3.4%)		
Mymensingh	22(2.1%)	4(0.4%)	1(0.1%)	27(2.6%)		
Sylhet	5(0.5%)	1(0.1%)	0(0.0%)	6(0.6%)		
Rajshahi	21(2.0%)	2(0.2%)	0(0.0%)	23(2.2%)		
Rangpur	13(1.2%)	3(0.3%)	0(0.0%)	16(1.5%)		
Total	908(86.4%)	133(12.7%)	10(1%)	1051(100%)		

The P-value attained from the x2 test of the Pearson Chi-square, results were tabulated as number (%) and the significant level was p<0.05.

Table 07 displays the p-value, which was higher than 0.05 at 0.982. Division and Respondents' Diagnosis showed a statistically insignificant correlation.

5.1 Introduction

The analysis and discussion are about identifying published papers & determining the relevance of the acquired data. This chapter discusses the study's findings in relation to its goals and research topics. The general findings of the current investigation are presented in the part that follows, along with a comparison of the findings with those of previous studies of a similar nature carried out in other nations. The study's objectives were to pinpoint the kinds and seasonal fluctuations in stroke incidence. The participants' sociodemographic details are provided in Section 5.2, along with a comparison of the findings with those of previous research of a similar nature. Seasonal factors are shown in Section 5.3 along with a comparison of the findings with those of other research of a similar nature. Comparing the findings with those of previous research of a similar nature, Section 5.4 explains the factors connected to stroke.

5.2 Patients' Socio-Demographic Characteristics

The majority of participants were male which was 80.3% (844) of the total participants while female participants were only 19.7% (207), which supports the study conducted in 2001 in which it was recorded that males were affected more than females (Hannan et al., 2001). Based on research carried out by Fodor et al.,2018, 47.18% (572) of the total participants were males and 52.81% (511) were females which means females were affected more than males which is opposite to this study. Based on research done by Karagiannis et al.,2010, 41% (3403) of the total participants were males and 59% (4801) were females which means females were affected more than males which is opposite to this study. According to Turin et al., 2008 in Japan, males were affected more which was 54% (893) of the total participants while female participants were only 46% (772), which supports this study. According to Kumar et al., 2015 in India, males were affected more which was 70% (769) of the total participants while female participants were only 30% (330), which supports this study. According to Iqbal et al., 2015 in Pakistan, males were affected more which was 61% of the total participants while female participants were only 39% which also supports this study. According to Jin et al., 2018 in China, males were affected more which was 53% of the total participants while female participants were only

47% which also supports this study. According to Mondal et al 2022 in Bangladesh, males were affected more which was 55% of the total participants while female participants were only 45% which also supports this research. The average age of the study participants which was recorded in this research is 58.83 (SD-13.39) with 41 % (431) of patients aged 61 or above while in another study stroke was seen to be more common in people aged 51 or above and mean age 56.18 ±12.86 which is approximately similar with this study (Hannan et al., 2001). According to Turin et al.,2008 in Japan, the average age of the research participants which was recorded was 69.4 years which is quite greater with this study. The greatest age at which a stroke occurred in this study was 105, while the lowest age at which one occurred was 20 years old. In different research carried out in Pakistan in 2015, Iqbal et al. discovered somewhat comparable results: the highest age at which a stroke occurred was 101, while the lowest age at which one occurred was 23. According to this study, stroke affected urban populations 68.8% (723) and rural populations 31.2% (328) more frequently. Further research carried out in Bangladesh in 2022 by Mondal et al. discovered that stroke impacted urban areas more frequently—58.9% [14904] than rural areas—41.1%. The research required participants to be at least 20 years old and no older than 105 years old. The standard deviation was 13.39369. The mean was 58.8382. 10.4% (109) of participants were equal to or younger than 40 years old, 21.3% (224) were between 41 and 50 years old, 27.3% (287) were between 51 and 60 years old, and 41% (431) were older than or equal to 61 years old. Similar results were noted in the study by Mondol et al. (2012), which showed that the frequency of stroke rose beyond the age of 40 (84.3%), with the 51–60-year-old age group having the highest frequency (31.1%), while in this study, the highest frequency was found in the age group over 60 years (41%). In contrast to this study, Mondol et al. (2012) reported that the incidence of stroke dropped considerably beyond 60 years (23.7%). Additionally, they reported that women made up 26.6% and men made up 73.4%, which is roughly in line with the study's findings. The peak incidence was determined to be between 51 and 70 years old in research conducted in Bangladesh by Hossain et al. (2011), which is roughly in line with the findings of this study. According to this study, the incidence of stroke was lowest in Sylhet and greatest in Dhaka, at 65.6% (689). Similar to our findings, different research carried out in Bangladesh

in 2022 by Mondal et al. discovered that the lowest stroke incidence was in Mymensingh at 4% (15) and the highest incidence was in Dhaka at 30% (93).

5.3 Incidence Season of Storke Occurrence

The summer has the largest occurrence rate in this study (31.9%), whereas the spring has the lowest incidence rate (4.50%) (47). Similar findings to this study were reported in another study carried out by Hannan et al. in 2001 in Bangladesh, which discovered that the incidence of stroke occurrence was greater in the summer than in the winter. In the summer of 121, they discovered incidences of stroke. Hemorrhagic stroke was at 28.1% (34) and ischemic stroke was at 71.9% (87) in the summer, although there were 34 winter stroke cases. Hemorrhagic stroke came in at 47.6% (16) and ischemic stroke at 52.9% (18). The results of this study are consistent with another study by Mateen et al. (2012) done in Bangladesh, which discovered that hemorrhagic strokes, which are deadly strokes, were more common in the winter months of December through March as opposed to the summer months of June through September. There was a negative correlation found for hemorrhagic stroke and a positive correlation found for ischemic stroke. This research's findings are substantially different from another study by Chu et al. (2018) that revealed the highest incidence of strokes occurred in the winter (116862), followed by the spring (113689), summer (13569), and fall (113618). This study's findings are substantially different from theirs, which indicated that winter was a more common season for ischemic stroke admissions. In a different study by Jussi et al. (2017) in Finland, they discovered that contrary to the outcomes of this study, autumn has the highest incidence of all three main subtypes of stroke (subarachnoid hemorrhage, intracerebral hemorrhage, and ischemic stroke), while summer has the lowest incidence.

Fodor et al. (2018) discovered in another study that the winter months of December and January have the highest frequency of ischemic stroke in Romania. The autumnal months of September through October have the lowest incidence of ischemic stroke. While SAH had its highest frequency during the summer, ICH had its highest incidence throughout the winter, but in this study, the researcher found that summer months have the greatest incidence of ischemic stroke. The spring months have the lowest incidence of ischemic stroke which is quite dissimilar to the findings in this study. Fodor et al., 2018 stated that SAH had its highest frequency during the summer, which is quite dissimilar to the findings

in this study. Fodor et al., 2018 stated that ICH had its highest incidence throughout the winter but in this study, the researcher found that ICH had its highest incidence throughout the late autumn, the second highest incidence of intracerebral hemorrhage was in winter. In this study, the researcher found that there was a statistically significant association between the incidence month and gender of the respondents where the p-value was 0.000 which was less than 0.05. The researcher also found that there was a statistically significant association between the incidence season and gender of the respondents where the p-value was 0.047, which was less than 0.05.

5.4 Stroke Type of the Patients

The study found that of the 908 participants, 86.4% experienced an ischemic stroke, 12.7% had an intracerebral hemorrhagic stroke, & 10 participants had a subarachnoid hemorrhage. After all, the majority of research showed that the risk of ischemic stroke was larger than that of hemorrhagic stroke. In another research, 89.47% (969) of the participants had an ischemic stroke, 8.68% (94) had an intracerebral hemorrhage, and 1.85% (20) had a subarachnoid hemorrhagic stroke (Fodor et al., 2018). Similar results were observed in another study by Tamasauskiene et al. (2017), which indicated that 80.4% of patients had an ischemic stroke and 19.6% had a hemorrhagic stroke. This suggests that the incidence of ischemic stroke is higher than that of hemorrhagic stroke. An ischemic stroke is more common than a hemorrhagic stroke, according to data from another study (Mondal et al., 2022) that was conducted in Bangladesh. It found that 79.7% (213) of the participants had an ischemic stroke, 15.7% (42) had an intracerebral hemorrhage, and 4.6% (12) had a subarachnoid hemorrhagic stroke. Another study by Hannan et al. (2001) in Bangladesh found that 67.7% (105) of the participants had an ischemic stroke, 31.0% (48) had an intracerebral hemorrhage, and 1.3% (02) had a subarachnoid hemorrhagic stroke. These results roughly correspond to the findings of this study, indicating that the incidence of ischemic stroke is higher than that of hemorrhagic stroke. Another research by Kumar et al. (2015) in Bangladesh discovered that 60.3% (663) of the participants had ischemic strokes, while 39.7% (436) had hemorrhagic strokes. This indicates that the prevalence of ischemic strokes is greater than that of hemorrhagic strokes, which is roughly in line with the results of this study. Karagiannis et al. (2010) discovered in another study that 78.8% of the patients in Northern Greece had an ischemic stroke, 11.1% had an intracerebral

hemorrhage, and 3.5% had a subarachnoid hemorrhagic stroke. 6.6% had TIA, indicating that ischemic stroke is more common than hemorrhagic stroke, which is roughly in line with the study's findings. In this study, the researcher found that there was a statistically significant association between the incidence season and diagnosis of the respondents where the p-value was 0.000, which was less than 0.05. The study also found that there was a statistically non-significant correlation between the division and diagnosis of the respondent where the p-value was higher than 0.05 at 0.982. The study also found that there was a statistically non-significant correlation between the incidence season and division where the p-value was 0.288, over 0.05.

CHAPTER VI	CONCLUSION

Finding the kinds and seasonal fluctuations in stroke incidence was the study's main goal. Seasonality was seen in the incidence of strokes. Summertime saw a marked increase in the incidence of both ischemic & subarachnoid hemorrhagic strokes compared to other seasons. There was a higher prevalence of intracerebral hemorrhagic stroke in late fall and winter compared to other seasons. The temperature was shown to be negatively correlated with intracerebral hemorrhagic stroke, and a positive correlation with ischemic stroke and subarachnoid hemorrhagic stroke. Different age groups showed differences in gender, season, and type of stroke. Understanding the seasonal variable pattern in stroke incidence may serve as a foundation for therapeutic and preventative approaches in the field of cerebrovascular disease.

| CHAPTER- VII | LIMITATIONS & RECOMMENDATION |

No research can be completely accurate, thus there may be some restrictions. There were a few restrictions on this study, which may be seen in the findings below:

7.1 Strength & Limitations

7.1.1 Strength of the Study

The research findings on seasonal variations and types of stroke occurrence in Bangladesh have significant clinical Practice Implications, teaching, and development activities & public health and policy.

Clinical Practice:

- **Risk Assessment**: Knowing the seasonal trends in stroke incidence enables medical providers to recognize times when patients are most vulnerable. For example, the increased occurrence in the summertime implies that certain preventative actions are necessary during this time of year.

- **Patient Management**: Seasonal changes might help clinicians customize stroke prevention plans. For instance, stressful summertime lifestyle changes (such as drinking more water and wearing sunscreen) or addressing particular risk factors that are more common throughout particular seasons.

- **Resource Allocation**: Hospitals that anticipate seasonal variations in stroke admissions can more effectively utilize their resources. Timely care delivery is ensured by being prepared during high-demand periods.

Teaching & Education

- **Medical Curriculum Enhancement**: Future healthcare practitioners will be well-informed if medical education includes information regarding seasonal fluctuations in stroke incidence. Having this knowledge can improve clinical judgment.

- **Public Awareness**: People can take preventive action by being informed about seasonal fluctuations and stroke risk factors. Campaigns to raise awareness can highlight seasonal risk factors and encourage good habits.

Development Activities:

- **Research Priorities**: The fundamental processes behind the seasonal fluctuations in stroke can be investigated further. Researching lifestyle modifications, biological cycles, and climate-related variables can help develop preventative measures.

- **Telemedicine & Remote Monitoring**: Using telemedicine and other forms of technology, stroke patients can be kept under observation throughout high-risk seasons. Monitoring and conversations from a distance can improve follow-up care.

- **Climate-Responsive Intervention**: Seasonal health concerns should be taken into account in infrastructure construction, urban planning, and disaster preparedness. Policies that adapt to changing climate conditions can reduce the risk of stroke in severe weather.

Public Health & Policy:

- **Health Campaigns**: Stroke prevention can be the focus of public health campaigns during particular seasons. Programs for targeted awareness can teach communities about early warning indicators and risk factors.

- **Policy Formulation**: These findings can be used by policymakers to create seasonal variation-based guidelines for stroke therapy and prevention. Regional variations and disadvantaged groups can be addressed by policies.

7.1.2 Study Limitations

The study depended on secondary data, which might not have all the necessary information required for the study.

- The research was carried out at a one Dhaka hospital, which may not reflect the situation in other parts of the country. Multi-center studies could provide a more comprehensive picture.

- The study excluded Neurology OPD patients, which might have led to the omission of valuable data related to stroke occurrence.

- There is not enough literature about identifying the seasonal variations and types of stroke occurrence in the Bangladeshi context.

7.2 Recommendations

7.2.1 Recommendations for Future Research

- Future research could expand the study area to include multiple hospitals across different regions of Bangladesh. This would give rise to a deeper comprehension of the seasonal variations & types of stroke occurrence in the country.

- Including data from Neurology Outpatient Departments could provide additional insights into stroke occurrence and its seasonal variations.

- While this study used secondary data, future research could benefit from primary data collection to gather more detailed and specific information.

7.2.2 Recommendations for Patients

- **Awareness and Prevention**: Patients should be educated about stroke risk factors, especially hypertension, diabetes, and dyslipidemia. Regular health check-ups and lifestyle modifications (such as maintaining a healthy diet, exercising, and avoiding tobacco use) are crucial for preventing strokes.

- **Seasonal Precautions**: During summer patients should take extra precautions. Staying hydrated, avoiding extreme heat, and managing stress can help reduce the risk of stroke. Also, during winter patients should take extra precautions.

7.2.3 Recommendations for Healthcare Professionals

- **Early Detection**: Healthcare providers should be vigilant in identifying stroke symptoms promptly. Timely diagnosis and intervention can significantly improve outcomes.

- **Risk Factor Management**: Emphasize the importance of managing risk factors like hypertension, diabetes, and dyslipidemia. Encourage patients to adhere to prescribed medications and lifestyle modifications. Understanding the seasonal pattern of fluctuation in stroke incidence may serve as a foundation for therapeutic and preventative approaches in the field of cerebrovascular disease.

- **Public Awareness Campaigns**: Collaborate with policymakers and community organizations to raise awareness about stroke prevention, symptoms, and the significance of seeking medical help promptly.

7.2.4 Recommendations for Public Health Policy & Research

- **Health Infrastructure**: Invest in stroke care infrastructure, including stroke units, rehabilitation centers, and telemedicine services. Ensure equitable access to stroke treatment across all regions.

- **Public Health Campaigns**: Launch nationwide campaigns to educate the public about stroke prevention, risk factors, and early recognition. Use media, community events, and schools to disseminate information.

- **Research and Surveillance**: Support ongoing research on stroke incidence, risk factors, and seasonal patterns. Regular surveillance can inform targeted interventions.

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APPENDIX:

Permission Letter

21 October 2023

To,

The Director,
Shaheed Suhrawardy Medical College and Hospital
Sher-E-Bangla Nagar, Dhaka-1207.

Subject: Seeking permission for data collection to conduct research Project.

Sir,

With due respect and humble submission to state that I am Md. Akhter Hossain, Student of Part II, M.Sc. in Rehabilitation Science(MRS) Program at Bangladesh Health Professions Institute (BHPI). I am conducting a research project entitled: "**Identification of the seasonal variations and types of stroke occurrence**". I want to collect data for my research project from medical records. So, I need permission for data collection. I would like to assure you that anything in the study will not be harmful to the participants.

I, therefore, pray and hope that you would be kind enough to grant my application and give the permission for data collection and oblige thereby.

Yours faithfully

Md. Akhter Hossain
Roll: 04
MRS, Part II
DU Registration No: 5400
Bangladesh Health Professions Institute (BHPI

Dr. Nanda Dulal Saha
Director (Incharge)
Shaheed Suhrawardy Medical College Hospital
Sher-E-Bangla Nagar, Dhaka.

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IRB Approval Letter

Ref: CRP-BHPI/IRB/10/2023/780

Date: 21/10/2023

To

Md. Akhter Hossain

M.Sc. in Rehabilitation Science

Session: 2021-2022

Student ID: 181210137

BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal "Identification of the seasonal variations and types of stroke occurrence" by ethics committee.

Dear Md. Akhter Hossain,

Congratulations.

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with yourself, as the principal investigator.

The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Research Proposal
2	Questionnaire (English & / or Bengali version)
3	Information sheet & consent form.

The purpose of the study is to identify the seasonal variations and types of stroke occurrence. The study involves the use of a Semi-structured questionnaire and a measurement tool to identify the seasonal variations and types of stroke occurrence. That may take approximately 10 to 15 minutes for participants to complete.to answer/fill in the questionnaire and there is no physical or psychological harm to the participants.

Questionnaire (English)

Identification of the Seasonal Variations and Types of Stroke Occurrence.

Respondent's Identification

Date of interview / / 2023   Participant ID No-

Name of the participant:

Address: Village-   Post Office-

           Thana-   Dist.-

Mobile No: Date:

Date of occurrence: ------------------

Section A: Socio-Demographic Information

SL No.	Question	Answer
1	Age	- ----- -Years
2	Gender	1. Female 2. Male
3	Living Area	1. Urban 2. Rural
4	Division	1. Dhaka 2. Chittagong 3. Barisal 4. Khulna 5. Mymensingh 6. Sylhet 7. Rajshahi 8. Rangpur

Section B: Season-Related Information

SL No.	Question	Answer
1	Month	1. January
		2. February
		3. March
		4. April
		5. May
		6. June
		7. July
		8. August
		9. September
		10. October
		11. November
		12. December
2	Season	1. Summer (Mid-April to Mid-June)
		2. Rainy Season (Mid-June to Mid-August)
		3. Autumn (Mid-August to Mid-October)
		4. Late Autumn (Mid-October to Mid-December)
		5. Winter (Mid December to Mid-February)
		6. Spring (Mid-February to Mid-April)

Section C: Stroke Related Information

SL No.	Question	Answer
1	Type of stroke	1. Ischemic Stroke 2. Intracerebral Hemorrhage 3. Sub-arachnoid Hemorrhage

<p align="center">প্রশ্নপত্র (বাংলা)</p>

<p align="center">"ঋতুগত তারতম্য এবং স্ট্রোক সংঘটনের ধরন সনাক্তকরণ"</p>

উত্তরদাতার পরিচয়

সাক্ষাৎকারের তারিখ: --/--/----

অংশগ্রহণকারীর নাম: অংশগ্রহণকারী আইডি নম্বর-

ঠিকানা: গ্রাম-   ডাকঘর-

থানা-   জেলা-

মোবাইল নম্বর: তারিখ:

ঘটনার তারিখ: ---

বিভাগ A: সামাজিক-জনসংখ্যা সংক্রান্ত তথ্য

ক্রমিক সংখ্যা	প্রশ্ন	উত্তর
১	বয়স	--------বছর
২	লিঙ্গ	১. মহিলা ২. পুরুষ
৩	বসবাসের এলাকা	১. শহুরে ২. গ্রামীণ
8	বিভাগ	১. ঢাকা ২. চট্টগ্রাম ৩. বরিশাল 8. খুলনা ৫. ময়মনসিংহ ৬. সিলেট ৭ রাজশাহী ৮. রংপুর

বিভাগ B: ঋতু-সম্পর্কিত তথ্য

ক্রমিক সংখ্যা	প্রশ্ন	উত্তর
১	মাস	১. জানুয়ারি ২. ফেব্রুয়ারি ৩. মার্চ ৪. এপ্রিল ৫. মে ৬. জুন ৭. জুলাই ৮. আগস্ট ৯. সেপ্টেম্বর ১০. অক্টোবর ১১. নভেম্বর ১২. ডিসেম্বর
২	ঋতু	১. গ্রীষ্ম (এপ্রিল মাসের মধ্যভাগ থেকে জুন মাসের মধ্যভাগ পর্যন্ত) ২. বর্ষাকাল (জুন মাসের মাঝামাঝি থেকে আগস্ট মাসের মাঝামাঝি পর্যন্ত) ৩. শরৎ (আগস্ট মাসের মাঝামাঝি থেকে অক্টোবর মাসের মধ্যভাগ পর্যন্ত) ৪. হেমন্তকাল (অক্টোবর মাসের মধ্যভাগ থেকে ডিসেম্বর মাসের মধ্যভাগ পর্যন্ত) ৫. শীতকাল (ডিসেম্বর মাসের মধ্যভাগ থেকে ফেব্রুয়ারি মাসের মধ্যভাগ পর্যন্ত) ৬. বসন্ত (ফেব্রুয়ারি মাসের মধ্যভাগ থেকে এপ্রিল মাসের মধ্যভাগ পর্যন্ত

বিভাগ সি: স্ট্রোক সম্পর্কিত তথ্য

ক্রমিক সংখ্যা	প্রশ্ন	উত্তর
১	স্ট্রোকের ধরণ	১. ইস্কেমিক স্ট্রোক ২. ইন্ট্রাসেরিব্রাল হেমোরেজ ৩. সাব-অ্যারাকনয়েড হেমোরেজ