Faculty of Medicine

University of Dhaka

Risk Factor of Shoulder Subluxation among Stroke Patients: A Case Control Study.

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Session: 2019-2020

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DICLARATION

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ACKNOWLEDGEMENT

First of all, I would like to pay my gratitude to Almighty Allah who has given me the ability to complete this project in time with success. The second acknowledgement must go to my parents who have always inspired me for preparing the project properly. I am extremely grateful to my honorable and praiseworthy Supervisor Dr. Abul Kasem Mohammad Enamul Haque, Principle, Saic College of Medical Science and Technology (SCMST) for giving me his valuable time, his keen supervision and excellent guidance without which I could not be able to complete this project.

I am also very thankful to Zahid Bin Sultan Nahid, Assistant professor and Head, department of physiotherapy, SCMST; Md. Shahidul Islam, Assistant Professor & Clinical Head Department of Physiotherapy, SCMST; Asma Arjo, Assistant Professor, Department of physiotherapy. Md. Furatul Haque,Assistant Professor,Department of Physiotherapy, Md. Billal Hossain, Lecturer, Department of physiotherapy, Saic College of Medical Science and Technology (SCMST); Md. Forhad Hosenn, Lecturer, Department of physiotherapy, Shahid Afridi, Lecturer, Department of physiotherapy SCMST and also all of my respected teachers for helping me in this study.

I am grateful to the intern Physiotherapists, Department of Physiotherapy, SCMST, Mirpur – 14, Dhaka for their support throughout the period of this study. I wish to thank the Librarian of SCMST and his associates for their kind support to find out related books, journals and also access to internet.

Finally I would like to thanks all the participants who willingly participated as the study population during the conduction of my study and the entire individual who were directly or indirectly involved with this study.

LIST OF ACRONYMS

BMRC	Bangladesh Medical Research Council
DALYS	Disability-Adjusted Life Years
HSC	Higher Secondary Certificate
HSP	Hemiplegic Shoulder Pain
IRB	Institutional Review Board
ROM	Range of Motion
SCMST	SAIC College of Medical Science and Technology
SPSS	Statistical Package for the Social Sciences
SSC	Secondary School Certificate
SSE	Scapular Stability Exercises
VAS	Visual Analog Scale
WHO	World Health Organization

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ABSTRACT

Introduction: Shoulder subluxation is a common complication following stroke, leading to pain, reduced upper limb function, and impaired quality of life. Identifying associated risk factors is crucial for early prevention, rehabilitation, and improving patient outcomes, especially in hospital settings in Bangladesh where post-stroke care is still developing.

Objectives: The objective of this study was to identify the risk factors associated with shoulder subluxation among stroke patients.

Methodology: A case-control study was conducted among 87 stroke patients, including 38 participants with shoulder subluxation (cases) and 49 without subluxation (controls). Data were collected by interview using a pre-tested questionnaire, along with clinical examinations assessing muscle tone, muscle power, and positioning. Statistical analysis was performed using SPSS, including chi-square and t-tests to determine associations between risk factors and shoulder subluxation.

Result: The study revealed that reduced muscle tone was the main risk factor for shoulder subluxation, with 52.6% of affected patients showing Grade 0 tone ($p = 0.001$). Patients with shoulder subluxation also had a lower BMI (21.31 ± 2.47) than controls (23.05 ± 2.96; $p = 0.004$). A previous stroke history was more frequent among cases (15.8%) and showed a near-significant ($p = 0.061$). Subluxation was slightly more common within 1–6 months after stroke. No significant relation was found with age, gender, or stroke type. Overall, low muscle tone, lower BMI, and early post-stroke stage appear to increase the risk of shoulder subluxation.

Conclusion: Shoulder subluxation among stroke patients was primarily associated with reduced muscle tone and early post-stroke period. Identification of at-risk patients, proper positioning, physiotherapy, and caregiver guidance are essential to prevent subluxation and improve functional recovery.

Key words: *Shoulder Subluxation, Stroke, Risk Factors, Muscle Tone, Case-Control Study.*

CHAPTER-I INTRODUCTION

1.1:Background:

The term ‘stroke’ originates from the Greek word ‘apoplexia’, meaning a sudden and severe attack, as if struck by a fatal blow. However, it would be misleading to equate the modern understanding of stroke entirely with the classical notion of apoplexy (Coupland et al., 2017, p.10).

In 1970, the World Health Organization defined stroke as 'rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin. Stroke is the greatest cause of persistent disability in adults. Up to 80% of first-time survivors have functional deficits, including hemiparesis of the contra lateral upper extremity (Aho et al. 1980, p. 113).

Each year, around 795,000 strokes occur in the United States, making it the fifth leading cause of death and the foremost contributor to long-term adult disability (As G. 2013, p. 237). Projections suggest that between 2012 and 2030, the number of stroke cases will rise by 3.4 million, largely due to population aging and a reduction in stroke-related fatalities (Ovbiagele et al. 2013, p.2365). Although stroke mortality in the U.S. has declined over the past two decades, recent data indicate that this trend may have plateaued. For example, subclinical cerebrovascular disease such as silent infarction has been detected through brain imaging in nearly 28% of adults over the age of 65 (Ovbiagele et al. 2013, p.2365).

Stroke remains one of the leading causes of long-term disability worldwide, often resulting in motor weakness, sensory impairment, and muscle imbalance that affect upper limb function (Lee, 2015). Among post-stroke complications, shoulder subluxation is one of the most frequent and disabling, particularly during the early flaccid stage when muscle tone and voluntary control are reduced. This partial dislocation of the humeral head from the glenoid cavity can lead to shoulder pain, decreased range of motion, and delayed rehabilitation outcomes, all of which significantly limit functional recovery and independence (Holmes et al., 2020).Stroke is generally classified into two primary types: ischemic stroke, caused by a blockage that restricts blood flow to the brain, and hemorrhagic stroke, which arises from

bleeding due to a ruptured blood vessel. Both forms lead to brain tissue damage and disruption of normal neurological function, often resulting in long-term impairments (Campbell et al., 2019, p. 317).

According to modern clinical guidelines, a stroke is a medical emergency that occurs when a blood vessel supplying the brain is either blocked (ischemic stroke) or ruptured (hemorrhagic stroke), often resulting in long-term neurological impairment (Katan and Luft, 2018, p. 541).

Stroke patients have mal-aligned bodies, weak muscles, and poor voluntary control. The damaged arm's functionality may be compromised by these issues. Because weakened muscles frequently affect scapular stabilizers, a paretic arm may cause a change in scapular orientation. Such weakness makes upper extremity motor dysfunction worse (Hardwick and Lang 2011, p.20). Optimal upper limb function requires the capacity to control movement and maintain scapular posture. The scapula gives the gleno-humeral joint regulated movement and dynamic stability. Because the scapula's architecture and biomechanics enable regulated movement of the shoulder joints, it plays a major part in supporting shoulder joint function. Recent research has concentrated on the necessity of creating upper extremity exercises due to their importance (Baskurt et al. 2011, p. 175).

Ischemic stroke is the most prevalent form of stroke, responsible for approximately 85% of all cases. It occurs when a cerebral artery becomes obstructed, either by a thrombus forming at the site or an embolus traveling from another location. This blockage restricts blood flow, depriving brain tissue of oxygen and nutrients, ultimately resulting in cell damage or death (Campbell et al., 2019, p. 317).

Hemorrhagic stroke occurs when a blood vessel in the brain ruptures, causing bleeding either within the brain tissue (intracerebral) or in the surrounding space (subarachnoid). This bleeding leads to a sudden rise in intracranial pressure and disrupts normal blood flow, often resulting in swift and serious brain damage (Saini et al., 2016, p. 606).

In individuals who have suffered a stroke, particularly those with hemiplegia, shoulder subluxation commonly arises due to significant muscle weakness and impaired motor control. The muscles responsible for stabilizing the shoulder joint

become inactive or weakened, compromising joint integrity. As a result, the humeral head of the upper part of the arm, bone tends to shift downward and partially dislocate from the glenoid fossa, the socket of the shoulder joint. This displacement contributes to pain, reduced mobility, and can hinder rehabilitation progress (Kumar et al., 2016, p. 273).

Hemiplegic shoulder pain (HSP) is a frequent complication after stroke that can lead to depression and reduced quality of life. It negatively impacts the functional recovery of the upper limb and limits the ability to perform activities of daily living (ADLs). This condition slows rehabilitation progress and increases the level of dependency on caregivers. HSP also contributes to reduced participation in social and physical activities, further affecting overall well-being (Karaahmet et al., 2019, p. 36).

Shoulder subluxation is one of the main reasons for hemiplegic shoulder pain after a stroke. It happens when the shoulder joint becomes unstable due to weak muscles. This condition can cause pain, limit arm movement, and slow down recovery of the upper limb, making daily activities harder for the patient (Fujimura et al., 2020, p. 847).

Glenohumeral subluxation refers to the excessive movement or partial displacement of the humeral head away from the glenoid fossa. This condition is commonly observed in stroke patients with hemiplegia and is linked to muscular weakness and loss of motor control around the shoulder joint. One of the visible signs is an increased gap between the acromion and the humeral head, indicating a loss of joint congruency. The altered alignment results from compromised mechanical stability within the glenohumeral joint, making the shoulder more prone to pain, limited function, and further complications during rehabilitation (Razaq and Azam Rathore, 2016, p. 42).

After a stroke, shoulder subluxation on the paralyzed side often occurs due to the weakening or relaxation of key stabilizing muscles, particularly the deltoid and supraspinatus. This muscle inactivity causes the scapulohumeral joint to lose its proper alignment. The constant downward pull of the unsupported, paralyzed upper limb further contributes to the displacement of the humeral head, increasing joint instability and the risk of shoulder complications (Fujimura et al., 2024, p. 216).

further emphasized that early detection, proper limb support, and functional electrical stimulation can significantly reduce the incidence and severity of subluxation in stroke survivors.Similarly, highlighted that motor recovery stage, sensory loss, and muscle tone are independent predictors influencing shoulder stability after stroke (Katsura et al., 2024, p.9893).

Shoulder subluxation is considered one of the key contributors to hemiplegic shoulder pain (HSP) following a stroke. It is characterized by a non-traumatic, partial or complete shift in the alignment between the scapula and the humerus across multiple planes and directions. This altered joint positioning, when compared to the unaffected shoulder, disrupts normal biomechanics and can lead to pain, limited mobility, and further functional decline in stroke patients (Lee et al., 2018, pp. 1–9).

Hemiplegic shoulder pain (HSP) develops through multiple factors, including shoulder subluxation due to muscle weakness, adhesive capsulitis causing joint stiffness, bursitis from inflammation, and shoulder-hand syndrome. These conditions often overlap, leading to pain, limited mobility and delayed recovery in stroke patients (Chuang et al., 2017, p.4).

Shoulder subluxation is commonly managed using electrical stimulation, strapping, orthosis to provide support and enhance shoulder movement. However, there is limited evidence to confirm that these treatments can completely prevent or correct subluxation. It also remains uncertain whether they effectively improve upper limb function. Further research is needed to establish their true benefits and effectiveness (Lee et al. 2015, p. 61).

1.2 Justification:

Shoulder subluxation is a frequent complication following a stroke, and it can significantly affect a patient's recovery and independence. It often causes pain, limits arm movement, and delays rehabilitation progress. This condition not only impacts the patient's quality of life but also increases their dependence on caregivers and the healthcare system, creating a long-term burden on families and society. Although many international studies have explored the causes and effects of shoulder subluxation in stroke patients, there is very limited data available from our country. The healthcare system, patient characteristics, and treatment approaches may differ from other countries, so local research is needed to understand the specific risk factors and challenges in our setting. By identifying the risk factors of shoulder subluxation among stroke patients in our country, this study aims to provide important information for improving clinical care. The findings will help healthcare professionals develop more effective treatment plans and rehabilitation strategies. Furthermore, the results can support health policymakers in creating targeted programs to reduce complications and improve patient outcomes.

Therefore, this research is necessary and timely. It will fill a gap in current knowledge and contribute to better healthcare for stroke patients in our region.

1.3: Research question:

Is muscle tone associated with shoulder subluxation in stroke patients?

1.4 Hypothesis:

1.4.1 Null hypothesis:

There is no association between muscle tone of stroke and shoulder subluxation .

$H_0 : \mu_1 - \mu_2 = 0$

1.4.2 Alternative hypothesis:

There is association between muscle tone of stroke and shoulder subluxation.

$H_a : \mu_1 - \mu_2 \neq 0$

Here,

H_0 = Null hypothesis

H_a = Alternative hypothesis

μ_1 = Mean of duration of shoulder subluxation of the participants of case.

μ_2 = Mean of duration of shoulder subluxation of the participants of control.

1.5 Objectives of the study:

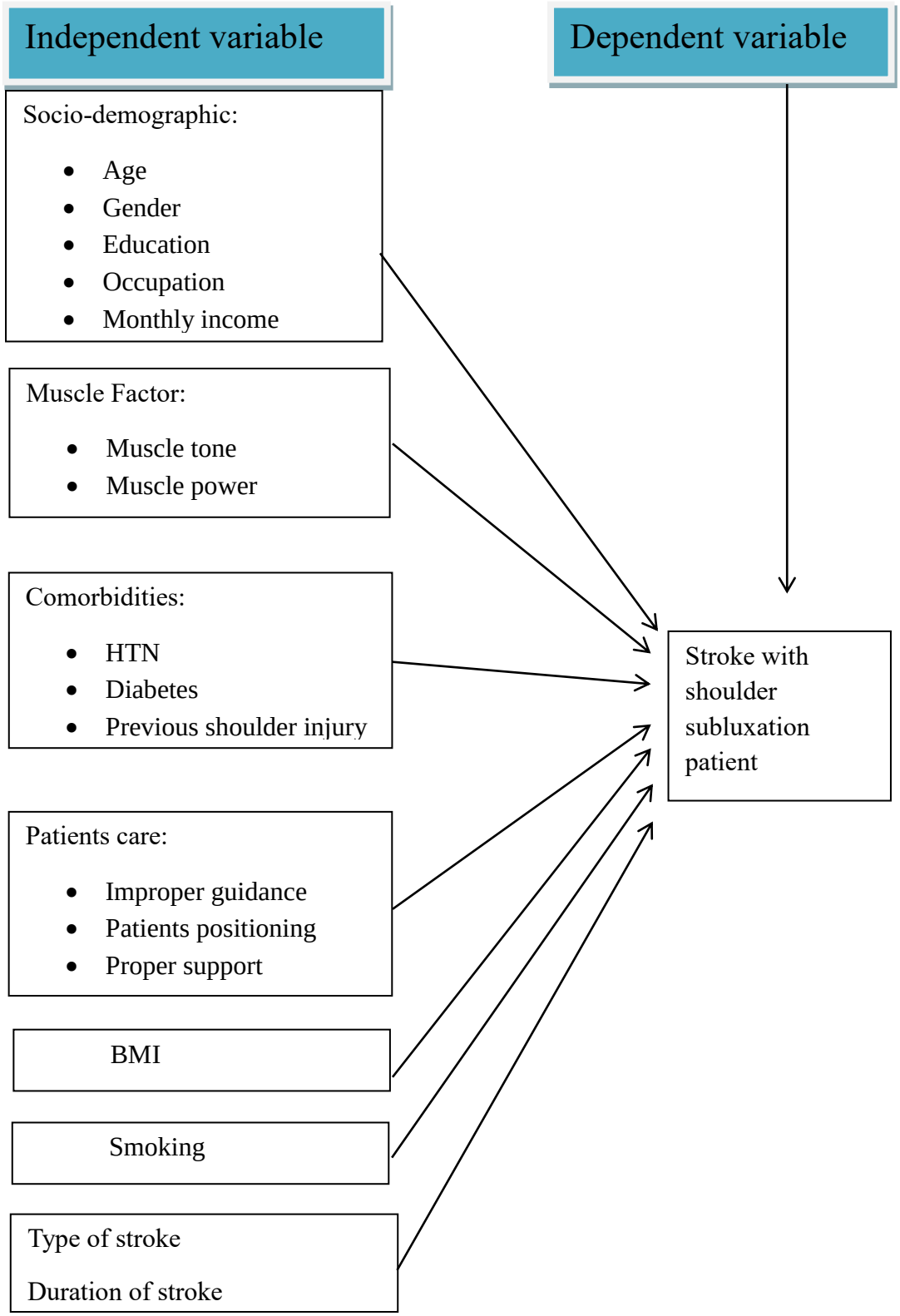
General Objective

To identify the risk factors associated with shoulder subluxation among stroke patients attending different physiotherapy centers in Dhaka.

Specific Objectives

1. To identify and recruit stroke patients with shoulder subluxation from different physiotherapy centers for the present study.
2. To select patients with stroke without shoulder subluxation from different physiotherapy centers as controls for the present study.
3. To determine the BMI of the study participants of both case and control groups.
4. To assess the power of muscles by applying Oxford manual muscle grading test of the participants of case and control group.
5. To assess the muscle tone of the study participants by applying Modified Ashworth Scale.
6. To analyze the association between duration, physical exercise, age, smoking, gender, socio-demographic characteristics and shoulder subluxation of the participants.

1.6 Conceptual Framework



1.7 Operational Definitions:

Stroke: A sudden neurological deficit caused by disruption of blood supply to the brain, resulting from either ischemic infarction or intracerebral hemorrhage. Diagnosed and confirmed by a physician through neuroimaging (CT scan/MRI), documented in the patient's medical record. For this study, stroke cases are categorized as:

Ischemic stroke → obstruction of blood flow (clot-related).

Hemorrhagic stroke → rupture of a blood vessel causing bleeding in the brain.

Stroke Duration: Time elapsed since the occurrence of stroke. Calculated in months from the date of stroke onset to the date of data collection, then categorized (1–6 months, 7–12 months, >12 months).

Shoulder subluxation: Partial dislocation of the shoulder joint characterized by a palpable gap between the acromion and humeral head .Measurement : Assessed clinically by palpation and graded using the finger-breadth method (0–3 fingers). Presence of ≥1 finger gap is considered subluxation.

History of Previous Stroke: Past occurrence of cerebrovascular accident prior to the index stroke. Documented in patient's history or medical record (Yes/No).

Age: Age of the participants for the present study defined as the completed years since birth, self-reported or verified from official documents. It was treated as a continuous variable.

Gender: Gender was recorded as self-reported by the participant:

- Male
- Female
- Other (if applicable)

Muscle tone: Level of resistance felt during passive movement of the affected limb. Measurement Assessed by using Modified Ashworth Scale (Grade 0–4). For analysis, grouped as hypotonia (Grade 0), normal/slight (Grade 1), and spastic (Grade ≥2).

Hypertension: Defined as,

- Prior diagnosis of hypertension by a physician, or
- Currently on anti-hypertensive medication, or
- Blood pressure ≥ 140/90 mmHg on two separate readings during data collection.

Diabetes Mellitus: Metabolic disorder characterized by hyperglycemia due to impaired insulin secretion or action. Identified from medical history, clinical records, or ongoing use of antidiabetic medication.

Monthly Income: Monthly income refers to the total household income in Bangladeshi Taka (BDT) per month, as self-reported. It was categorized as:

- <15,000 BDT
- 15,000–30,000 BDT
- 30,000 BDT

Education of the Participant: Education was categorized based on the highest level of formal education completed by the participant. It was collected from the participants during interview process.

CHAPTER-II LITERATURE REVIEW

Stroke is a major global contributor to both death and disability, with around 15 million cases reported annually. This places a substantial burden on healthcare systems worldwide. One frequent complication following a stroke is shoulder pain, which can be highly disabling. Studies show its prevalence ranges from 12% to 49%. This condition significantly affects patients' recovery and quality of life. (Nadler et al., 2020, p.144)

Shoulder subluxation commonly occurs after stroke due to biomechanical instability of the gleno-humeral joint. A study from Karachi reported a 21.8% prevalence of shoulder subluxation among stroke and TIA patients, with females at higher risk .The condition is often associated with hemiplegia and leads to difficulty in mobility, balance, and performing activities of daily living. Clinical assessment is usually done through palpation, which is considered valid in post-stroke cases. The overall incidence ranges from 17% to 81% among stroke survivors. Management typically includes slings and wheelchair attachments to reduce shoulder strain and improve outcomes. (Khan et al., 2020, p. 74).

Hemiplegic shoulders exhibit significantly more structural abnormalities than unaffected shoulders or those of healthy individuals . In a study involving 45 stroke patients, 100% of hemiplegic shoulders showed one or more abnormalities, compared to 55.6% of unaffected shoulders and 43.3% of controls. Common pathologies included biceps tendon tendinosis (48.9%), inferior shoulder subluxation (44.4%), and joint effusions (44.4%). Notably, biceps tendinosis was more frequent in patients with poor motor function. This underscores the strong association between neuromuscular impairment and shoulder joint pathology following stroke (Kim et al., 2020, p.113).

The authors stated that shoulder subluxation is a frequent complication in post-stroke hemiplegia, particularly in the acute stage, with incidence rates ranging from 7% to 81%. It may delay upper limb recovery and reduce proprioception. The research showed that active shoulder exercises, such as sling-suspension therapy, led to significantly greater improvements in subluxation distance, proprioceptive accuracy, and motor function scores compared to conventional therapy . Traditional methods

like slings and taping were reported to have limitations and adverse effects. (Fill et al., 2021, p.112)

The authors reported that shoulder subluxation in post-stroke patients can be effectively evaluated using ultrasonography, which revealed AGT differences ranging from 1 to 10 mm depending on subluxation grade. The study showed that higher-grade subluxation was associated with muscle atrophy, effusion, and in some cases, capsular or supraspinatus tears. Following intervention, a reduction in AGT distance and improvement in soft tissue condition was observed in most participants. These findings highlight the clinical value of ultrasound in guiding targeted rehabilitation strategies for shoulder subluxation (Arya et al., 2021, p.1310).

In comparison to other emerging nations, the age-adjusted incidence rates reported in South Asia are greater (145-262 per 100,000). Stroke incidence has also been found 17 to be greater in studies of South Asian migrants in affluent nations. With intracerebral hemorrhage being the primary cause of the great majority of strokes, the incidence of stroke has been estimated to be 115-219 per 100,000 in nearby nations like China. Similar to other parts of the world, ischemic stroke is the most common stroke subtype in South Asia [22, 29]. According to epidemiological studies of age-adjusted prevalence in other nations, there are 500-800 strokes per 100,000 people [32-34]. Studies conducted in South Asia, however, indicate a lower age-adjusted frequency of 47-545 per 100,000 (Amber et al. 2012, p. 126).

The level of neurological problems after a stroke depends on several factors, including how well blood can reach the affected area through other vessels, the exact location of the injury, how big it is, and how quickly proper treatment is started. In many patients, the symptoms improve on their own within about three weeks as swelling in the brain decreases. When the problems last beyond three weeks, they are called residual impairments, which may lead to long-term disability. Strokes can be grouped in different ways: by their cause, such as bleeding, clot, or blockage; by the part of the brain affected, like the anterior or middle cerebral artery and by their clinical course, such as young stroke, worsening stroke, minor stroke, major stroke, or transient ischemic attack (O'Sullivan et al. 2019, p. 50).

In a study of 1390 stroke patients, the prevalence of post-stroke shoulder pain was 11.6%, with shoulder subluxation accounting for 32.1% of cases. The authors reported that most patients had multiple contributing factors such as rotator cuff injury and frozen shoulder. Diabetes, limited joint movement, spasticity, and low Brunnstrom stages were identified as independent risk factors. These findings highlight the complex etiology of shoulder pain and the need for early multidisciplinary intervention (Hao et al., 2022, p.145)

Many elements, including neurological and mechanical ones, are thought to contribute to HSP. The gleno-humeral subluxation is one mechanical characteristic (Kumar et al. 2023, p. 220). A stroke occurs when a vascular lesion damages central neural tissue, leading to an abrupt onset of neurological impairment. A "Transient Ischemic Attack" (TIA) or a "Complete Stroke" are the two types of stroke. Hypertension, diabetes, the use of contraceptives, alcohol consumption, polycythemia, and atrial fibrillation are among the general risk factors for stroke (Khan et al. 2020, p. 74). Stroke ranks third globally in terms of causes of death, after coronary heart disease and cancer (Banerjee et al., 2006). Stroke is the world's number one cause of death and disability. Stroke is the second most prevalent cause of death in the world, accounting for 9.7% of all fatalities, after heart disease, killing 5.7 million people year.

Stroke victims and their families frequently experience emotional and financial challenges as a result of the significant disabilities that it frequently leaves in its wake. Also, the expenditures to healthcare systems are substantial (Avinav et al. 2012, p. 40) In many nations, stroke is a leading cause of death and disability. According to reports, there were 6.5 million stroke deaths and roughly 25.7 million stroke survivors worldwide in 2013. 10.3 million New instances of stroke and 113 million DALYs (disability-adjusted life-years) lost to stroke. The bulk of stroke deaths and lost DALYs-75.2% of all stroke-related deaths and 81.0% 16 of all associated DALYs were seen in developing nations.

Participants in the control group only received routine exercise therapy. This included soft tissue and joint mobilization, range of motion activities (either passive or assisted), proper positioning, splinting, stretching, electrical stimulation, reaching tasks, functional mobility practice, walking training, and balance exercises. Sensory re-education was also used, such as stroking the skin with fabrics of different textures,

placing objects like coins, buttons, or keys in the hand, or tracing shapes, letters, and numbers on the skin (Vispute and Kanase 2018, p. 88). Since the underlying condition cannot be cured, rehabilitation is considered the most common and effective approach to improve the quality of life of stroke patients (Dajpratham et al. 2006, p. 2050).

A clinical study conducted at Ruijin Hospital investigated post-stroke complications through systematic screening and follow-up of 239 eligible stroke patients. The study employed a structured follow-up approach at two and four months post-discharge, using in-hospital reassessments, clinic visits, and telephone interviews. This method allowed for effective tracking of patient outcomes and complications, including shoulder-related impairments. The findings underscore the significance of early identification and continuous monitoring in stroke rehabilitation (Hao et al. 2022, p.145).

Rehabilitation is described as a health strategy that helps people with existing or potential disabilities achieve and maintain the best possible level of functioning within their environment (Hesse et al. 2013, p. 627). Shoulder subluxation after stroke occurs due to changes in muscle mechanics. During the flaccid stage, the normal action of the supraspinatus and posterior deltoid muscles is weakened, so they cannot stabilize the joint. As a result, gravity pulls the humerus downward during abduction and flexion, leading to caudal subluxation (Paci et al. 2007, p. 100).

To prevent this, various orthopedic devices are often applied in the early stage after stroke to support the shoulder joint and reduce gleno-humeral subluxation. Common supports include Henderson shoulder rings, Bobath rolls, Harris hemi-slings, Rolyan humeral cuff slings, Cavalier shoulder supports, arm troughs, lapboards, and shoulder strapping. Research by Nadler et al. shows that shoulder orthoses can help reduce hemiplegic shoulder pain by minimizing vertical subluxation. The most effective devices provide both proximal and distal support, but they must be used with caution to avoid contractures (Nadler and Pauls 2017, p. 450).

CHAPTER:III METHODOLOGY

3.1 Study design:

It was a case control study to determine the risk factors of shoulder subluxation among stroke patients.

3.2 Study area:

The relevant data were collected from the stroke patients with subluxation attending Saic College of Medical Science and Technology, Mirpur 14, Dhaka.Pain paralyse hospital, Manikganj. Rehab max physiotherapy centre,Savar.Unique pain & paralysis centre, Mirpur 11. in Dhaka.

3.3 Study place:

The study was carried out at Saic College of Medical Science and Technology, Mirpur, Dhaka.

3.4 Duration of the study:

The duration of the study was June 2024 to July 2025.

3.5 Study population:

Stroke patients attending different physiotherapy centers Constituted the study population for the present study.

3.6 Sample Size: The sample size for the present study was calculated by the following statistical formula.

$$n = \left[\frac{z_\alpha\sqrt{2p(100-p)} + z_\beta\sqrt{p_1(100-p_1)+p_2(100-p_2)}}{p_1 - p_2}\right]^2$$

Here,

$p_1 = 32.5$ [anticipated probability of exposure among cases (from previous study)].

$p_2 = 16.4$ [anticipated probability of exposure among control (from previous study)].

$p = (p_1 + p_2) \div 2$

$p = \frac{48.9}{2} = 24.45$

$z_\alpha = 1.96$

$z_\beta = 1.28$

Now,

$$\text{n} = \frac{P_1\,(100-P_1) - P_2(100-P_2)}{(P_1-P_2)^2} \times (Z_\propto + Z_\beta)^2$$

$$= \frac{2193.75+1371.04}{259.21} \times 10.4976$$

$$= \frac{3564.79}{259.21} \times 10.4976$$

$$= 13.752 \times 10.4976$$

$$= 144.368$$

(Suethanapornkul et al., 2008, p.1887)

3.7 Sampling technique:

Convenient sampling technique was applied to select the participants for the present study.

3.8 Eligibility criteria:

3.8.1 Inclusion criteria:

- Stroke Survivors with shoulder subluxation (Singh et al. 2021, p. 113).
- Age: 60 years and above (Yoo et al., 2020, p.451).
- Participants who are willing and able to commit to the study requirements, including attending therapy sessions (Nee et al. 2012, p. 24).

3.8.2 Exclusion criteria:

- Patient with Severe cognitive impairment or dementia (Singh et al. 2021, p. 120).
- Individuals with severe physical limitations (Basson et al. 2014, p. 107).
- Patients who are unwilling or unable to participate (Nee et al. 2012, p. 27).

3.9 Method of data collection:

3.9.1 Technique of data collection:

Face to face formal interview technique adopted to collect data from both the case and control of the study.

3.9.2Instrument of data collection:

A pre-tested structured questionnaire was used as an instrument of data collection. Both open and close ended questions were included in the questionnaire.

3.9.3 Tools of data collection:

- Weight machine.
- Measuring tape
- Modified Ashworth Scale (MAS):

A standardized clinical assessment tool used to measure spasticity in the affected muscles.

- Manual Muscle Testing (MMT) Scale (Oxford/MRC Scale):
  A widely used tool for assessing muscle strength. This scale grades voluntary muscle power on a range from 0 (no contraction) to 5 (normal strength against full resistance), thus enabling systematic evaluation of muscle performance.

3.9.4 Procedure of data collection:

The present study was a case-control study. The researcher submitted her research protocol to the Ethical Review Board of Saic College of Medical Science and Technology for approval to carry out the study. Permission was granted by the Ethical Review Board in due time. Stroke patients with shoulder subluxation served as the cases for the study. Similarly, stroke patients without shoulder subluxation were selected as controls. Matching of the groups was performed prior to data collection. The aims and objectives of the study were explained in detail to the participants, and written informed consent was obtained before conducting interviews. Interviews were carried out in a cordial and comfortable environment. A pretested questionnaire was used to collect data from both groups. At the end of each interview, the participants were thanked for their time and cooperation.

3.10 Data management:

3.10.1 Editing of data:

It characterized by reviewing and cleaning the collected data to identify and correct errors, inconsistencies, or missing information. The primary goal of data editing is to ensure the accuracy, reliability, and completeness of the data before proceeding with data analysis. Proper data editing helps to produce valid and meaningful research results.

3.10.2 Data Entry:

The coded data were entered into a computer based on the variables of the study.

3.10.3 Analysis of data:

The data were analyzed by using the Statistical Package for the Social Sciences (SPSS) program. Descriptive statistics, such as frequency, distribution, range, mean, and percentage, were performed. Inferential statistics (Chi square and *t* test) were used to analyze the relationship between independent and dependent variables.

3.10.4 Result:

The findings of the study have been presented with the tabulations and description in the result section of the thesis.

3.11 Ethical Considerations for the Study:

The investigator obtained written permission from the Institutional Review Board of Saic College of Medical Science and Technology to ensure the study met ethical standards. This study followed the BMRC and WHO guideline. Informed written consent was obtained from all the participants, ensuring they were fully aware of the study's purpose, procedures, and their right to withdraw. Finally, confidentiality of the data was maintained throughout the research, ensuring participants' privacy and the secure storage of sensitive information.

CHAPTER – IV RESULTS

The objective of the study was to identify the risk factors of shoulder subluxation among stroke patients. Relevant data of this study were collected from both case and control group by a pretested questionnaire. The data were analyzed by SPSS program. The results of the study have been presented with tables and discussion in the following section.

Table no.1. Frequency distribution of the patients by age and case-control.

Age group in years	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
31 – 45	9	23.7	8	16.3	17	19.5
46 – 60	19	50.0	17	34.7	36	41.4
61 years and above	10	26.3	24	49	34	39.0
Total	38	43.7	49	56.3	87	100.0

Regarding the frequency distribution of the participants by age group, it was found that out of 87 participants, 38 (43.7%) were in the case group (stroke with subluxation) and 49 (56.3%) were in the control group (stroke without subluxation). Among them, the highest proportion of participants (19; 50.0%) were from the 46 – 60 years age group, followed by 10 (26.3%) in the 61 and above age group, and 9 (23.7%) in the 31 – 45 years age group. In the control group, 24 (49.0%) patients were in the 61 years and above age group, 17 (34.7%) patients were in the 46 – 60 years group, and 8 (16.3%) patients were in the 31– 45 years group. Overall, the largest portion of participants (36; 41.4%) were between 46 – 60 years, followed by 34 (39.0%) aged 61 and above, and 17 (19.5%) aged 31 – 45 years. The distribution of age of the patients between case and control was not statistical significant (χ^2 = 40.228, *df* = 34, *p* = 0.214) [Table no. 1].

Table no.2. Frequency distribution of the patients by gender and case control.

Gender	Frequency				Total	
	case		Control			
	N	%	N	%	N	%
Male	25	65.8	35	71.4	60	69.0
Female	13	34.2	14	28.6	27	31.0
Total	38	43.7	49	56.3	87	100.

Regarding the frequency distribution of the patients by gender, it was observed that out of 87 participants, 38 (43.7%) were in the case group and 49 (56.3%) in the control group. Among the case group, 25 (65.8%) were male and 13 (34.2%) were female. On the other hand, in the control group, 35 (71.4%) were male and 14 (28.6%) were female. The association between gender and subluxation was found to be not statistically significant ($\chi^2 = 0.318$, $df = 1$, $p = 0.573$) [Table no. 2].

Table no.3. Frequency distribution of the patients by religion.

Religion	Frequency				Total	
	case		control			
	N	%	N	%	N	%
Islam	36	94.7	46	93.9	82	94.3
Hindu	2	5.3	3	6.1	5	5.7
Total	38	43.7	49	56.3	87	100.0

The study showed that, the frequency distribution of the patients by religion, it was found that out of 87 participants, 38 (43.7%) belonged to the case group and 49 (56.3%) to the control group. Among the cases, 36 (94.7%) patients were Muslim and 2 (5.3%) were Hindu. In the control group, 46 (93.9%) patients were Muslim and 3 (6.1%) were Hindu. Overall, the majority of the participants (94.3%) were Muslim, and only 5.7% were Hindu. The distribution of the religion of the patients between case and control was not statistically significant ($\chi^2 = 0.029$, $df = 1$, $p = 0.864$) [Table no. 3].

Table no.4. Frequency distribution of the patients by education:

Education	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Primary	6	15.8	8	16.3	14	16.1
JSC	3	7.9	5	10.2	8	9.2
SSC	7	18.4	14	28.6	21	24.1
HSC	6	15.8	6	12.2	12	13.8
Graduation	10	26.3	3	6.1	13	14.9
Post-graduation	1	2.6	1	2	2	2.3
Illiterate	5	13.2	12	24.5	17	19.5
Total	38	43.7	49	56.3	87	100.0

The study revealed that the distribution of patients by education level. Out of 87 participants, 38 were in the case group and 49 in the control group. In the case group, most patients (26.3%) completed graduation. Other levels were SSC (18.4%), HSC and primary (both 15.8%), illiterate (13.2%), JSC (7.9%), and post-graduation (2.6%). In the control group, most patients (28.6%) had SSC education. Others were illiterate (24.5%), primary (16.3%), HSC (12.2%), JSC (10.2%), graduation (6.1%), and post-graduation (2.0%). 8Overall, the most common education levels were SSC (24.1%) and graduation (14.9%). Very few participants (2.3%) completed post-graduation. The level of education of the participants between case and control was not statistically significant ($\chi^2 = 8.516$, $df = 6$, $p = 0.203$) [Table no.4].

Table no.5. Frequency distribution of the patients by occupation.

Occupation	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Job	13	34.2	11	22.4	24	27.6
Business	9	23.7	10	20.4	19	21.89
Farmer	4	10.5	14	28.6	18	20.7
Housewife	12	31.6	14	28.6	26	29.9
Total	38	43.7	49	56.3	87	100.0

Among the 87 participants, the largest group were housewives (29.9%), with 12 (31.6%) from the case group and 14 (28.6%) from the control group. A total of 24 participants (27.6%) were job holders — 13 (34.2%) cases and 11 (22.4%) controls. Business participants made up 19 (21.9%) of the total, including 9 (23.7%) cases and 10 (20.4%) controls. Farmers accounted for 18 participants (20.7%), with 4 (10.5%) from the case group and 14 (28.6%) from the control group. The distribution of occupation of the patients between case and control was not statistically significant ($\chi^2 = 4.612$, $df = 3$, $p = 0.203$) [Table no. 5].

Table no.6.Frequency distribution of the patients by duration of stroke in month.

Duration of stroke in month	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
1- 6	19	50.0	20	40.8	39	44.8
7 – 12	19	50.0	29	59.2	48	55.2
Total	38	43.7	49	56.3	87	100

The distribution of patients according to the duration of stroke (in months) revealed that in the case group, an equal proportion of patients (50.0%) had a stroke duration of 1–6 months and 7–12 months. In contrast, in the control group, a slightly higher proportion (59.2%) had a stroke duration of 7–12 months compared to 40.8% within 1 – 6 months. Although the proportion of patients with longer stroke duration (7 – 12 months) appeared greater in the control group, the difference between the groups was not statistically significant ($\chi^2 = 0.730$, $df = 1$, $p = 0.393$) [Table no.6].

Table no.7.Frequency distribution of the patients by previous stroke and case-control.

Previous stroke	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Yes	6	15.8	2	4.1	8	9.2
No	32	84.2	47	95.9	79	90.8
Total	38	43.7	49	56.3	87	100.0

Regarding the frequency distribution of the participants based on previous stroke history it was found that in the case group, 6 participants (15.8%) reported a previous stroke, compared to only 2 participants (4.1%) in the control group. The majority of both groups had no history of stroke, 84.2% in cases and 95.9% in controls respectively. The association between previous stroke and shoulder subluxation was found to be statistically nearly significant (χ^2 =3.513, *df* = 1, *p* = 0.061) [Table no.7].

Table no.8. Frequency distribution of the patients by smoking habit.

Smoking	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Yes	10	26.3	11	22.4	21	24.1
No	28	73.7	38	77.6	66	75.9
Total	38	43.7	49	56.3	87	100.0

Regarding the distribution of smoking habits among participants, it was observed that 10 individuals (26.3%) in the case group were smokers, compared to 11 individuals (22.4%) in the control group. The majority of participants in both groups were non-smokers 28 (73.7%) in the case group and 38 (77.6%) in the control group. The overall prevalence of smoking in the study population was 24.1% (21 out of 87 participants).The association between smoking habit and shoulder subluxation was not statistically significant ($\chi^2 = 0.175$, $df = 1$, $p = 0.676$) [Table no. 8].

Table no.9.Frequency distribution of the patients by type of stroke.

Type of stroke	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Ischemic	29	76.3	40	81.6	69	79.3
Hemorrhagic	9	50.0	9	50.0	18	20.7
Total	38	43.7	49	56.3	87	100.0

Regarding the type of stroke and its association with subluxation, it was found that among the case group, 29 patients (76.3%) had ischemic stroke, while 9 patients (50.0%) had hemorrhagic stroke. In the control group, 40 patients (81.6%) had ischemic stroke, and 9 patients (50.0%) had hemorrhagic stroke. The association between the type of stroke and subluxation was not statistically significant (χ^2 = 0.369, df = 1, p = 0.544) [Table No. 9].

Table no.10.Frequency distribution of the patients by co-morbidity.

Co-morbidity	Frequency				*P value*
	Case		Control		
	N	%	N	%	
Hypertension	35	92.1	43	87.8	0.509
Diabetes	18	47.4	12	24.4	0.026
Heart disease	2	5.3	1	2.0	0.414
Previous shoulder injury	1	2.6	0	1	0.253
None/other disease	2	5.3	5	10.2	0.401

The data presented in Table 11 shows the distribution of co-morbidities among the case and control groups. Hypertension was the most common co-morbidity in both groups, reported by 92.1% of the case group and 87.8% of the control group, though the difference was not statistically significant ($p = 0.509$).A significant difference was observed in the presence of diabetes, which was more frequent in the case group (47.4%) compared to the control group (24.4%), with a p-value of 0.026. Other conditions such as heart disease, previous shoulder injury, and other or no diseases showed no significant differences between the groups.This analysis suggests that diabetes may be more associated with the case group, while other co-morbidities were similarly distributed across both groups [Table No. 10].

Table no.11.Frequency distribution of the patients by guidance.

Guidance on proper positioning or shoulder care	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Yes	19	50.0	13	26.5	32	36.8
No	19	50.0	36	73.5	55	63.2
Total	38	43.7	49	56.3	87	100.0

Analysis of the data regarding guidance on proper positioning or shoulder care revealed that 19 participants (50.0%) in the case group had received such guidance, compared to only 13 participants (26.5%) in the control group. Conversely, half of the case group (50.0%) and a majority of the control group (73.5%) reported receiving no such guidance. The overall proportion of participants who had received guidance was 36.8% (32 out of 87). Statistical analysis showed a significant association between lack of guidance and shoulder subluxation ($\chi^2 = 5.070$, $df = 1$, $p = 0.024$) [Table no. 11].

Table no.12.Frequency distribution of the patients by positioning method.

Positioning	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Placing a pillow under the arm	7	18.4	5	10.2	12	13.8
Using an supporting device	16	42.1	12	24.5	28	32.2
Allowing the limb to hang freely	13	34.2	13	26.5	26	29.9
I am not sure how to positioning the arm	2	5.3	19	38.8	21	24.1
Total	38	43.7	49	56.3	87	100

The distribution of patients by their positioning method showed notable differences between the case and control groups. In the case group, the most commonly used positioning method was using a supporting device (42.1%), followed by allowing the limb to hang freely (34.2%) and placing a pillow under the arm (18.4%). Only a small portion (5.3%) reported uncertainty about how to position the arm.In contrast, a significant proportion of the control group (38.8%) reported being unsure how to position the arm, while fewer used supporting devices (24.5%) or allowed the limb to hang freely (26.5%). Placing a pillow under the arm was the least common method in both groups.Statistical analysis revealed a significant association between the positioning method and shoulder subluxation (χ^2 =13.492, *df* =3, *p* = 0.004) [Table No. 12].

Table no.13.Frequency distribution of the patients by support.

Support	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Always support	7	18.4	5	10.2	12	13
Sometimes support	16	42.1	12	24.5	28	32
Rarely support	13	34.2	13	26.5	26	29
Do not know how to support	2	5.3	19	38.8	21	24
Total	38	43.7	49	56.3	87	100

Support patterns among participants differed between the case and control groups. In the case group, the majority (42.1%) reported receiving support sometimes, followed by 34.2% who rarely received support. In the control group, the highest proportion (38.8%) reported that they did not know how to support. Overall, most participants were distributed across the "sometimes" and "rarely" support categories, with fewer reporting "always support" or "do not know how to support." A statistically significant association was found between the groups ($\chi^2 = 13.492, df = 3, p = 0.004$) [Table No. 13].

Table no.14.Frequency distribution of the patients by muscle tone.

Muscle tone in grade	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Grade 0	20	52.6	16	32.7	36	41.4
Grade 1	5	13.2	23	46.9	28	32.2
Grade 1+	6	15.8	10	20.4	16	18.4
Grade 2	4	10.5	0	0.0	4	4.6
Grade 3	3	7.9	0	0.0	3	3.4
Grade 4	0	0.0	0	0.0	0	0.0
Total	38	43.7	49	56.3	87	100

The distribution of patients according to muscle tone grading demonstrated a statistically significant difference between the case and control groups ($\chi^2 = 18.928$, df = 4, p = 0.001). In the case group, the majority of patients (52.6%) had Grade 0 muscle tone, followed by Grade 1+ (15.8%) and Grade 1 (13.2%). Higher grades of tone were observed only in the case group, with 10.5% in Grade 2 and 7.9% in Grade 3. In contrast, the control group predominantly exhibited Grade 1 tone (46.9%), followed by Grade 0 (32.7%) and Grade 1+ (20.4%), with no cases of Grade 2 or Grade 3. Statistical analysis showed statistically highly significant association between muscle tone grade and shoulder subluxation ($\chi^2 = 18.928$, $df = 4$, $p = 0.001$) [Table No. 14].

Table no.15.Frequency distribution of the patients by muscle power.

Muscle power in Grade	Frequency				Total	
	Case		Control			
	N	%	N	%	N	%
Grade-0	1	2.6	2	4.1	3	3.4
Grade-1	13	34.2	7	14.3	20	23.0
Grade-2	9	23.7	6	12.2	15	17.2
Grade-3	8	21.1	15	30.6	23	26.4
Grade-4	5	13.2	16	32.7	21	24.1
Grade-5	2	5.3	3	6.1	5	5.7
Total	38	43.7	49	56.3	87	100

Muscle power grades among participants varied between the case and control groups. In the case group, the majority had lower muscle power grades: 34.2% were Grade 1 and 23.7% were Grade 2. In contrast, the control group had more participants with higher muscle power grades: 30.6% were Grade 3 and 32.7% were Grade 4.Overall, most participants were spread across Grades 1 to 4, with fewer in Grade 0 and Grade 5. Statistical analysis showed no significant association between muscle power grade and shoulder subluxation ($\chi^2 = 9.588$, $df = 5$, $p = 0.088$) [Table No. 15].

Table no.16.Mean difference of BMI between case and control:

BMI	N	Mean	SD	*'t'* value	*p* value
Case	38	23.05	2.47	2.919	0.004
Control	49	21.31	2.96		

The mean BMI of the case group was 21.31 ± 2.47, whereas the control group had a mean BMI of 23.05 ± 2.96. The results show that the BMI was lower among the cases compared to the controls. An independent t-test was applied, which showed a statistically significant difference (t = 2.919, p = 0.004). This indicates that BMI differs significantly between the two groups .

CHAPTER – V DISCUSSION & LIMITATION

In this study, stroke patients with shoulder subluxation (cases) and without (controls) were similar in their age distribution: the most prevalent age group among cases was 46 – 60 years (50.0%), while in controls, the largest proportion was in the 61 years and above category (49.0%). Overall, the combined distribution showed 41.4% of participants falling into the 46 – 60 years group, 39.0% in the ≥ 61 years group, and 19.5% in the 31–45 years group. The statistical analysis did not reveal a significant age-related difference between groups (p = 0.214), suggesting that age may not be an independent risk factor for post-stroke shoulder subluxation. In contrast, in case-control settings where age was not a strong independent predictor of shoulder subluxation. For instance, (Qu et al. 2025 p.9) conducted a study of 128 hemiplegic stroke patients and found that age did not have a significant effect on acromion–greater tuberosity (A-GT) distance an ultrasound marker of subluxation severity. Instead, factors such as stroke type, supraspinatus muscle thickness, and Brunnstrom motor recovery stage emerged as significant predictors.

In this study, the gender distribution among stroke patients revealed a higher prevalence of shoulder subluxation in males. Specifically, 65.8% of the case group were male, compared to 71.4% in the control group. This finding aligns with previous research indicating a higher incidence of shoulder subluxation in male stroke patients. A systematic review by (Anwer and Alghadir, 2020, p.4978) reported that female gender was a significant risk factor for hemiplegic shoulder pain and subluxation after stroke. However, our study's findings suggest that male stroke patients may be more susceptible to shoulder subluxation, highlighting the need for further investigation into gender-specific risk factors and rehabilitation strategies.

In this study, education level varied across participants but showed no significant difference between those with shoulder subluxation and those without. Among cases, the highest proportion had completed graduation (26.3%), compared to SSC level (28.6%) among controls. Overall, the most common education bands were SSC (24.1%) and graduation (14.9%), with post-graduation being rare (2.3%). This suggests that formal education level did not meaningfully influence the likelihood of shoulder subluxation after stroke. While direct comparisons are limited, demographic

factors such as education often reflect socioeconomic and rehabilitative access rather than intrinsic biological risk. A systematic review on hemiplegic shoulder pain closely related to shoulder subluxation identified predictors including age, female gender, increased tone, sensory impairment, and hemispatial neglect, but didn't list education level among significant risk factors (Anwer and Alghadir, 2020, p.4967) .This supports your finding that education level is unlikely to play a major role in subluxation risk.

Previous strokes can result in cumulative neurological deficits, including greater motor impairment, reduced muscle tone, and delayed neuromuscular control all factors that contribute to shoulder instability and subluxation. (Arya et al., 2021, pp.1309–1317) emphasized the pivotal role of the supraspinatus and posterior deltoid muscles in maintaining shoulder stability post-stroke; repeated strokes can exacerbate weakness in these muscles, increasing the risk of subluxation. In the present study, patients with a history of previous stroke were found more often in the subluxation group (15.8%) than in the control group (4.1%). Although the association did not reach statistical significance ($p = 0.061$), the result was close to significant. This suggests that prior stroke history may play a role as a potential risk factor for shoulder subluxation in post-stroke patients.

Several case–control and cohort studies have explored the relationship between stroke duration and shoulder subluxation. Lee et al. (2015) conducted a retrospective case–control study and found that stroke duration exceeding 6 months was significantly associated with a higher risk of shoulder subluxation, particularly when combined with weak elbow extensors and loss of proprioception (Lee et al., 2015, p.62). Similarly, in a multicenter cohort study, demonstrated that shoulder pain often linked with subluxation was more likely to occur between 2–6 months post-stroke (OR = 4.0, 95% CI = 2.06–7.79), suggesting that the subacute period represents a critical window of vulnerability (Suethanapornkul et al., 2008, p.1886). In the present study, stroke duration did not show a statistically significant association with shoulder subluxation ($p = 0.393$). Among the cases, an equal proportion of patients (50.0%) experienced stroke duration of 1–6 months and 7–12 months, while in the control group, the majority (59.2%) had a duration of 7–12 months. This suggests that, within the first year post-stroke, the length of time since onset may not be an independent determinant of shoulder subluxation.

In the present study, 15.8% of participants in the case group reported a history of previous stroke, compared to only 4.1% in the control group. Although the majority of participants in both groups had no prior stroke history (84.2% of cases and 95.9% of controls), the difference between groups was nearly statistically significant (p = 0.061). This trend suggests that recurrent stroke may increase the likelihood of shoulder subluxation. Similar findings were reported by Lee et al. (2015, p.62), who observed that patients with a prior history of stroke were more prone to shoulder complications, including subluxation, due to poorer motor recovery and greater muscle weakness following subsequent neurological insults. Supporting this, Anwer and Alghadir (2020, p.4967) highlighted that recurrent stroke contributes to long-term muscle tone imbalance and impaired joint control, thereby heightening the risk of hemiplegic shoulder pain and instability. Taken together, these findings suggest that while the statistical association in the present study did not reach significance, clinically, a history of recurrent stroke appears to predispose patients to shoulder subluxation by exacerbating hypotonia, spasticity, and motor impairment.

In this study, 26.3% of participants in the case group and 22.4% in the control group were smokers, with an overall smoking prevalence of 24.1% among the 87 participants. Despite this, the association between smoking habits and shoulder subluxation was not statistically significant (χ^2 = 0.676), suggesting no direct link between smoking and the occurrence of shoulder subluxation in this cohort. This finding contrasts with the studies that have explored the relationship between smoking and musculoskeletal disorders. For instance, a study by Lee et al. (2015, p-62) found that smoking was associated with an increased risk of shoulder subluxation in stroke patients, possibly due to the adverse effects of smoking on muscle function and healing processes.

In our sample, stroke type (ischaemic vs haemorrhagic) was not significantly associated with shoulder subluxation. This is consistent with sonographic data from Idowu et al., who found no significant difference in acromion–greater tuberosity (A-GT) distance between ischaemic and haemorrhagic strokes (p = 0.335) (Idowu et al., 2017, pp. 108–110). By contrast, a recent ultrasound-based study likewise identified stroke type (history of cerebral haemorrhage) among independent risk factors alongside lower Brunnstrom stage and reduced supraspinatus thickness (Qu et al.,

2025). Taken together, the literature is mixed: studies using imaging and multivariable models sometimes detect an elevated risk with haemorrhagic stroke, whereas other datasets (including ours) show no independent association**.** Differences in phase post-stroke, measurement methods (radiograph/fingers-breadth vs ultrasound metrics), covariate adjustment, and sample composition likely explain these discrepancies.

The distribution of co-morbidities among the case and control groups, hypertension was the most frequent co-morbidity in both groups, reported by 92.1% of the case group and 87.8% of the control group, with no statistically significant difference ($p = 0.509$). A significant difference was observed in the prevalence of diabetes, which was more common in the case group (47.4%) compared to the control group (24.4%), with a p-value of 0.026. Other conditions, such as heart disease, previous shoulder injury, and miscellaneous or no diseases, did not show significant differences between groups. This finding suggests that diabetes may be an important associated factor for shoulder subluxation, whereas other co-morbidities appear to be similarly distributed across both groups. Comparable evidence supports this association. Fuentes-Murguía et al. (2024, pp. 31–33) reported that post-stroke patients with diabetes had a higher prevalence of shoulder disorders, including subluxation, likely due to microvascular complications and impaired connective tissue healing. Similarly, Idowu et al. (2017, pp. 110–111) noted that metabolic comorbidities such as diabetes may exacerbate musculoskeletal vulnerability in hemiplegic shoulders, though their findings did not reach statistical significance. Collectively, this suggests that while hypertension remains the most common comorbidity in stroke patients, diabetes may act as a more specific risk factor for shoulder subluxation.

This finding suggests that inadequate education on shoulder positioning and preventive care may contribute to the risk of shoulder subluxation after stroke. Prior research has emphasized that early caregiver and patient education on positioning, limb handling, and preventive strategies significantly reduces the incidence of hemiplegic shoulder complications (Kumar et al., 2019, p. 412). Similarly, (Pandian et al. 2016, p. 89) reported that structured caregiver training and proper arm support play a critical role in reducing shoulder subluxation and pain in post-stroke patients. Therefore, the present study reinforces the importance of incorporating structured

education and guidance on shoulder care as part of routine stroke rehabilitation to minimize complications.

The analysis of arm positioning methods among stroke patients revealed significant differences between those with and without shoulder subluxation.These findings suggest that improper or uncertain positioning may contribute to shoulder subluxation, while using supporting devices provides mechanical support to reduce downward traction on the glenohumeral joint. This is consistent with prior studies emphasizing that structured caregiver education and proper arm positioning can effectively reduce the risk of shoulder complications in post-stroke patients (Ada et al., 2017, p. 56; Raj et al., 2021, pp. 70). Therefore, integrating caregiver training and consistent use of supportive devices should be prioritized in stroke rehabilitation programs to prevent shoulder subluxation.

The distribution of muscle power grades differed between the case and control groups. Statistical analysis revealed no significant association between muscle power grade and the presence of shoulder subluxation ($p = 0.088$), suggesting that while lower muscle strength is observed in those with subluxation, it may not independently predict its occurrence. These findings are consistent with previous studies indicating that although reduced muscle strength can contribute to impaired limb support, shoulder subluxation is a multifactorial condition influenced by a combination of muscle tone, spasticity, postural control, and external support (Hao et al., 2022, p. 415). Some studies have suggested that interventions targeting muscle strengthening alone may not be sufficient to prevent subluxation; rather, a comprehensive rehabilitation program addressing muscle tone, passive support, and positioning is more effective in mitigating risk (Arya et al., 2021, p. 210).

In this study, the mean BMI of the case group (shoulder subluxation) was significantly lower at 21.31 ± 2.47, compared to 23.05 ± 2.96 in the control group ($t = 2.919$, $p = 0.004$), indicating that lower BMI may be associated with an increased risk of shoulder subluxation post-stroke. This contrasts with findings in chronic stroke populations reporting that higher BMI is linked to poorer motor recovery and functional mobility, suggesting a negative influence of obesity on rehabilitation

outcomes (Sheffler et al., 2012, p.1057). Although that study addressed BMI's role in motor and mobility recovery rather than shoulder positioning, the results collectively imply that both ends of the BMI spectrum may impact post-stroke outcomes but through different mechanisms. In the context of shoulder subluxation, lower BMI might reflect diminished overall muscle mass and reduced periscapular support, increasing susceptibility to instability. This highlights the importance of evaluating nutritional status and muscle bulk preservation as components of post-stroke shoulder management.

Limitation of the study:

- Convenience sampling technique was applied to select case and control groups from the population.
- Some of the participants should lack of co-operation and did not answer some question.
- The researcher is a fourth-year physiotherapy B.Sc. student. His first work is this thesis. The student's knowledge of techniques and strategies in the research team was inadequate. Therefore, the thesis has several shortcomings.
- By expanding the study to include a wider range of groups, larger sample sizes, and more thorough objectives, the validity and applicability of any follow-up findings will be enhanced.

CHAPTER- VI CONCLUSION AND RECOMMENDATION

Conclusion:

This case-control study was conducted to identify the risk factors of shoulder subluxation among stroke patients. Subluxation among stroke in Bangladesh is significantly associated with various medical, lifestyle, and demographic risk factors. This case-control study investigated the demographic, clinical, and behavioral factors associated with shoulder subluxation in stroke patients. The findings revealed that shoulder subluxation was prevalent across various age groups and both genders, with no statistically significant association with age, gender, education level, occupation, smoking habits, or type of stroke. Duration of stroke and previous stroke history also showed no significant association, although previous stroke demonstrated a near-significant. Importantly, clinical factors such as reduced muscle tone and improper arm positioning were strongly associated with the development of shoulder subluxation, highlighting the critical role of musculoskeletal integrity and patient care practices in post-stroke management. Co-morbid conditions, particularly diabetes, were more common among patients with subluxation, suggesting that systemic health factors may influence musculoskeletal complications post-stroke.

Overall, the study underscores the multifactorial nature of shoulder subluxation following stroke. While demographic and lifestyle factors appear less influential, clinical care, muscle tone maintenance, and patient guidance on shoulder positioning play a pivotal role in prevention. These findings emphasize the need for early assessment, individualized rehabilitation strategies, and structured caregiver education to minimize the risk of shoulder subluxation, improve functional outcomes, and enhance quality of life for stroke survivors.

Recommendations:

1. **Expand Sample Size:**
   Future research should include larger and more heterogeneous samples to increase the statistical power and generalizability of findings regarding risk factors for shoulder subluxation among stroke patients.
2. **Longitudinal Follow Up:**
   Incorporate longer follow-up periods to assess the progression of subluxation over time and to evaluate the effectiveness of early preventive interventions.
3. **Include Objective Assessment Tools:**
   Future research may use advanced tools such as ultrasonography, digital goniometry, and electromyography (EMG) for accurate measurement of subluxation, shoulder alignment, and muscle tone.
4. **Assess Functional and Quality of Life Outcomes:**
   Employ standardized scales such as the Stroke Impact Scale or Barthel Index to capture the impact of shoulder subluxation on daily functioning and overall quality of life.
5. **Investigate Preventive Strategies:**
   Comparative studies should be conducted to assess the effectiveness of different preventive measures such as shoulder support devices, electrical stimulation, and positioning techniques in reducing the risk of subluxation.
6. **Explore the Role of Comorbidities:**
   Consider including patients with common comorbid conditions (e.g., hypertension, diabetes, obesity) to evaluate whether these factors modify the risk of subluxation.
7. **Evaluate Rehabilitation Protocols:**
   Studies should compare conventional therapy with advanced interventions such as robotic-assisted therapy, kinesio taping, and neuromuscular re-education programs to determine the most effective management strategies.

8. **Caregiver and Staff Training:**
   Develop and implement structured training programs for caregivers and rehabilitation staff to improve patient handling, positioning, and home-based exercise adherence.

9. **Multicenter and Community-Based Studies:**
   Conduct multicenter and community-level studies to ensure findings are applicable across different healthcare settings and patient populations, particularly in low-resource environments.

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APPENDIX:

Verbal Consent Form

Assalamuaalaikum/ Namashkar,

I am Bm Lamia Rasul, student of B. Sc. In Physiotherapy, Saic College of Medical Science and Technology (SCMST), affiliated with Faculty of Medicine, University of Dhaka. For the partial fulfillment of my bachelor degree, I have to conduct a research project and it is a part of my study. My Research title is "Risk Factor of Shoulder Subluxation among Stroke Patients".

I do expect that the interview will take 20- 30 minutes. I also offer you to ask any sort of questions when you fell it is necessary to get insight.

I would like to inform you that this is a purely academic study and will not be used for any other purpose. I assure you that all the data will be kept confidential. Your participation will be voluntary. You may have the rights to withdraw your consent and discontinue from the study at any point of time. You also have the right not to answer any other question that you don't like of this questionnaire.

If you have any query about the study, you may contact with me or my supervisor Dr. Abul Kasem Mohammod Enamul Haque, Principle of SCMST.

So, may I have your consent to proceed with the interview? Yes……., No……..

Signature of participants & Date……..

Signature of researcher & Date……

Signature of the witness & Date…….

Questionnaire

Title: **Risk Factors of Shoulder Subluxation among Stroke Patients.**

Date: ……..
Name of the patient……
Address:……
…

1.	Age (completed): ……yrs	/___/
2.	Gender: [1] Male [2] Female [3] Others:…….	/___/
3.	Religion: [1] Islam [2] Hindu [3] Buddhist [4] Christian	/___/
4.	Education: [1] PSC [2] JSC [3] SSC [4] HSC [5] Graduated [6] Post graduated	/___/
5.	Occupation: [1] Student [2] Job [3] Business [4] Farmer [5] Housewife	/___/
6.	What is the duration of your Stroke?..... months	/___/
7.	Have you had previous strokes? [1] Yes [2] No	/___/
8.	Are you a smoker? [1] Yes [2] No	/___/
9.	Do you have shoulder subluxation? [1] Yes [2] No	/___/
10.	Type of Stroke: [1] Ischemic [2] Hemorrhagic [3] Not sure	/___/
11.	Do you have any of the following comorbidities? (Multiple response) [1] Hypertension [2] Diabetes [3] Heart disease [4] Obesity [5] Previous shoulder injury [6] Arthritis [7] None	/___/
12.	Did you receive any guidance on proper positioning or shoulder care to prevent subluxation? (knowledge) [1] Yes [2] No	/___/
13.	What methods do you use to position the patient's while sitting or lying down? (Proper positioning) [1]Placing a pillow under the arm [2] Using an support device (e.g., sling) [3]Allowing the limb to hang freely [4] I am not sure how to position the arm	/___/
14.	Do you support the patient while moving or transferring? [1] Always support [2] Sometimes support [3] Rarely support [4] Do not know how to support/No	/___/
15.	Muscle tone in the shoulder according to Modified Ashworth Scale?	/___/

	[1] Grade 0 [2] Grade 1 [3] Grade 1+ [4] Grade 2 [5] Grade 3 [5] Grade 4	
16.	Muscle power: [1] Grade 0 [2] Grade 1 [3] Grade 2 [4] Grade 3 [5] Grade 4 [6] Grade 5	/___/
17.	Height: ……meter	/___/
18.	Weight: ……kg	/___/
19.	BMI:	/___/
20.	Monthly income: ……..Taka	/___/

Name of the assessor: ……

SCMST-BPT/IRB/03-10/25/38

To
BM Lamia Rasul
4th Year Student of B.Sc. in Physiotherapy
Session: 2019-20, Registration No: 8786
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Subject: Approval of the thesis proposal **"Risk Factor of Shoulder Subluxation among Stroke Patients"** by ethics committee.

Dear Lamia Rasul
Congratulations.
The Institutional Review Board (IRB) of SCMST 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	Dissertation Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

The purpose of the study to assess the Risk Factor of Shoulder Subluxation among Stroke Patients. Data will be collected by both ended questioners that may take 30 to 40 minutes to fill in the questionnaire and there is no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 09.00 AM on 04th September 2024 at SCMST.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring during the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

04.09.24

Dr. Abul Kasem Mohammad Enamul Haque
Principal, SCMST &Chairman, Institutional Review Board (IRB)
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Date: 03/09/2024
To
The Chairman,
Institutional Review Board (IRB)
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216.
Subject: **Application for review and ethical approval.**

Dear Sir,

With due respect, I am Lamia Rasul, student of 4th year B.Sc. in Physiotherapy Program at SAIC College of Medical Science & Technology (SCMST), affiliated by the University of Dhaka. As per the course curriculum, I have to conduct a research project that entitled "Risk Factor of Shoulder Subluxation among Stroke Patients" under the supervisor Dr. Abul Kasem Mohammad Enamul Haque, Principal of SAIC College of Medical Science & Technology (SCMST)

The purpose of the study is assessing the Risk Factor of Shoulder Subluxation among Stroke Patients. Data will be collected by both ended questioners that may take 30 to 40 minutes to fill in the questionnaire and there is no likelihood of any harm to the participants. Data collectors will receive informed consent from all participants: any data collected will be kept confidential.

Therefore, I look forward to having your kind approval for the thesis proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

Lamia

BM Lamia Rasul
Student of 4th Year B.Sc. in Physiotherapy
Session: 2019-20 Reg: 8786
SCMST, Mirpur-14, Dhaka-1216, Bangladesh

SAIC COLLEGE OF MEDICAL SCIENCE AND TECHNOLOGY

Approved by Ministry of Health and Family Welfare
Affiliated with Dhaka University

Ref: SCMST-BPT/Data/12-03/25/06 Date: 19.03.2025

To

The Principal,

SAIC College of Medical Science and Technology,

Mirpur-14, Dhaka-1216, Bangladesh.

Subject: **Prayer for permission to collect data from SAIC College of Medical Science and Technology, Mirpur-14, Dhaka-1216, Bangladesh to conduct a research project.**

Sir,

With due respect and humble submission to state that I am a student of B.Sc. in Physiotherapy at SAIC College of medical science and technology (SCMST). As a part of our course curriculum, we have to conduct a research project for the partial fulfillment of the requirement for the degree of B.Sc. in Physiotherapy. My research title is "Risk Factors of Shoulder Subluxation among Stroke Patients: A Case Control Study" and the aim of the study is to identify the risk factors of shoulder subluxation among stroke patients.This is a case control study under the supervisor Dr. Abul Kasem Mohammad Enamul Haque, Principal, SCMST. I have chosen SAIC College of medical science and technology (SCMST) to collect data from stroke patients who have shoulder subluxation.

So, I, therefore, pray and hope that you would be kind enough to give permission for data collection that will help me to complete my study.

Allowed to collect data from the college.
19.03.25

Yours Faithfully

Lamia

Bm Lamia Rasul
B.Sc. in Physiotherapy (4th Year)
Session: 2019-2020
SCMST, Mirpur-14, Dhaka-1216, Bangladesh.

Dr. Abul Kasem Mohammad Enamul Haque
MBBS, M.Phil(PSM)
Principal
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Mirpur-14, Dhaka

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