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# MEASUREMENTS OF ANTHROPOMETRIC AND BIOCHEMICAL PARAMETERS IN PATIENTS WITH STROKE - A CASE-CONTROL STUDY

## *MEDIDAS DE PARÂMETROS ANTROPOMÉTRICOS E BIOQUÍMICOS EM PACIENTES COM AVC - UM ESTUDO DE CASO-CONTROLE*

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**Abstract**
Anthropometric and biochemical parameters play an important role in the development and outcome of stroke. The aim of this study was to find out the anthropometric and biochemical parameters in patients with stroke and to compare them with controls. Cross sectional study was

***Resumo***
*Os parâmetros antropométricos e bioquímicos desempenham um papel importante no desenvolvimento e no resultado do AVC. O objetivo deste estudo foi descobrir os parâmetros antropométricos e bioquímicos em pacientes com AVC e compará-los com os*

conducted from four hospitals of Pakistan from January 2024 to August 2024. 150 participants were recruited. In which 95 were stroke patients and 55 were normal control. A sample size of 92 was calculated based on prevalence of stroke, through an online calculator by using a 95% confidence interval and 5% confidence level. Results showed that 63.17% patients having ischemic stroke.37.3% showed involvement of Left middle cerebral artery (LMCA). Significant differences (P value ≥0.05) between two groups were found in mean values of WHR (cases =1.014±.237 control =0.922±0.126), Weight (cases=125.959±49.610lbs, control =165.782 ±29.686lbs), and waist circumference (cases =100.334 ±17.117, control=90.936 ±18.309. Level of HDL (cases=38.608 ±9.200, control=41.818±11.182) was high in control group and mean value of VLDL was significantly increase (P value ≥0.05) in control group (cases =35.7379±19.353 mean, control mean 54.181±18.515). Waist-hip ratio and waist circumference were predictors of stroke whereas weight, VLDL and HLD have a protective effect on the body from a stroke.

**Keywords:** Stroke. Anthropometric Parameters. Biochemical Parameter. Hip Waist Ratio.

*controles. Um estudo transversal foi realizado em quatro hospitais do Paquistão, de janeiro de 2024 a agosto de 2024. Foram recrutados 150 participantes. Destes, 95 eram pacientes com AVC e 55 eram controles normais. Uma amostra de 92 participantes foi calculada com base na prevalência de AVC, por meio de uma calculadora online, utilizando um intervalo de confiança de 95% e um nível de confiança de 5%. Os resultados mostraram que 63,17% dos pacientes apresentavam AVC isquêmico. 37,3% apresentaram envolvimento da artéria cerebral média esquerda (LMCA). Foram encontradas diferenças significativas (valor P ≥ 0,05) entre os dois grupos nos valores médios de WHR (casos = 1,014 ± 0,237 controle = 0,922 ± 0,126), peso (casos = 125,959 ± 49,610 libras, controle = 165,782 ± 29,686 libras) e circunferência da cintura (casos = 100,334 ± 17,117, controle = 90,936 ± 18,309). O nível de HDL (casos = 38,608 ± 9,200, controle = 41,818 ± 11,182) foi elevado no grupo controle e o valor médio de VLDL aumentou significativamente (valor P ≥ 0,05) no grupo controle (casos = 35,7379 ± 19,353 média, controle média 54,181 ± 18,515) . A relação cintura-quadril e a circunferência da cintura foram preditores de acidente vascular cerebral, enquanto o peso, o VLDL e o HLD têm um efeito protetor do corpo contra o acidente vascular cerebral.*

***Palavras-chave:*** *Acidente vascular cerebral. Parâmetros antropométricos. Parâmetro bioquímico. Relação cintura-quadril.*

## 1 INTRODUCTION

Stroke is the second leading cause of death worldwide and causing higher ratio of mortality and morbidity. It may be defined as a “Brain Attack” and occurs, due to blockade of blood supply of blood flow in an area of brain. It causes deprivation of oxygen and nutrients in the brain leading to death of brain cells [1]. According to the World Health Organization (WHO), 15 million people suffer from stroke worldwide each year. In Asia stroke incidence is increasing more than western countries. In 2002, 5.5 million patients died due to the stroke and approximately 20% death took place in India, Pakistan, Bangladesh, and Sri Lanka (South Asia) [2]. In Pakistan the yearly estimated incidence of stroke is 250/100,000, while yearly new reported case

350,000 fresh cases annually [3]. Due to the sedentary life style of population, the forecast is challenging [4] Modification of life style is best remedy to prevent mortality and morbidity due to stroke [5]. A remarkable difference in incidence of mortality and morbidity in nations with higher sedentary habits less awareness about the cause of stroke. Stroke morbidity and mortality rate is different in developing and developed countries. [6]. Association between Anthropometric parameters and cardiovascular conditions have been noticed 7]. . Higher body mass index (BMI) is strongly associated with higher blood pressure (BP), which can predispose to cardiovascular conditions such as ischemic heart disease and stroke [7]. Waist Hip ratio (WHR) values exceeding 0.80 in women and 0.95 in men are indicative of increased risk of cardiovascular[8].The waist circumference is correlated with the abdominal visceral adipose tissue accumulation and values >102 cm in men and >88 cm in women, are critical levels, according to NCEP- Adult Treatment Panel III [8].

Although anthropometric parameters play an important role in the development of stroke but importance of biochemical parameters cannot be died. Among biochemical parameters Hyperlipidemia is one of the major risk factors of stroke. Raised blood level of cholesterol (above 200 mg/dl) is an important risk factor in the pathogenesis of stroke. Elevated level of cholesterol not only participates in the pathogenesis but also gives the idea of severity of disease [9]. A higher risk of atherosclerosis in cerebral arteries is associated with dyslipidemia, which may result in sudden stoppage of blood flow to the brain either due to blood clot or rupture of blood vessel [9]. HDL less than 40mg/dl is significantly associated while higher level of Cholesterol. LDL and VLDL are found to be less associated dyslipidemias with the increase incidence of stroke [10]. Management of modifiable risk factors can significantly decrease the incidence of stroke [11]. Keeping in view the increase incidence of stroke, currently there is a need to add more information in literature regarding risk factors from developing countries. This study aims to find out the type of stroke, major artery involvement along with the anthropometric and biochemical parameters in stroke patients. Moreover, to compare these findings with control participants.

Innovatively bridging anthropometric and biochemical parameters in stroke patients, this case-control study seeks to unveil novel insights into the intricate interplay

between physiological metrics, potentially revolutionizing our understanding of stroke etiology and paving the way for targeted interventions.

## 2 MATERIALS AND METHODS

A cross-sectional survey was conducted through purposive sampling technique. Sample size was calculated 92 (researcher enrolled 95 patients) on the basis of prevalence of stroke 6.4% (3) in 12454 populations by using 5% confidence level and 95% confidence interval through online calculator [12].Data of Fifty five normal healthy participants were collected as control. After institutional Ethical approval data was collected from private and government hospitals of Lahore, Pakistan, from January 2024 to August 2024. After informed consent participants of both gender and age more than 18 years of old were included. Patients with other chronic diseases (liver disease, kidney disease, heart diseases musculoskeletal disorders etc;) were excluded from this study.

Questionnaire was developed from literature review and expert opinion and consists of two parts, 1st part is about demographic information including age, settlement, gender, Type of hospital, involvement of arteries and type of stroke (as evident by CT scan/ MRI report). Second part of questionnaire comprises of anthropometric measurements and biochemical parameter.

Anthropometric measurements were taken including height, weight, BMI (weight divided by height), waist circumference {WC (measured midway between the lower rib margin and the superior anterior iliac spine)} hip circumference {HC (taken at widest point of the greater trochanters)}, hip-waist ratio {HWR (HC divided by WC)}, waist-hip ratio {WHR (WC divided by HC)} For lipid profile, after approximately 12 hours fasting period 3ml of venous blood in dry sterile syringe was collected each subject (patients and controls). Blood samples were centrifuged at 2000 r.p.m for 10 minutes and sera was used for lipid profile test during 1-2 days. Serum total cholesterol was measured by enzymatic cholesterol esterase, peroxidase method, HDL by precipitation method and triglyceride by glycerol phosphate oxidase PAP method from commercially manufactured reagents kit by fully automated chemistry analyzer. Very low-density lipoprotein (VLDL) and LDL were calculated using Fried Ewald's formula [13]. The data was analyzed in SPSS software version 21. Descriptive analysis was used for

demographic information and inferential analysis was used for Anthropometric and biochemical parameters. P value ≥0.05 was taken as significant.

**Results:** The study's findings shed light on the characteristics of patients who experienced ischemic strokes, revealing that 63.17% of the participants fell into this category.

**Table 1**

*Demographic information and clinical Presentation*

| Variables | Sub type | Male | Female |
|---|---|---|---|
| **Type of hospital** | **Private** | 51 | 53 |
| | **Public** | 32 | 14 |
| **Location** | **Urban** | 62 | 46 |
| | **Rural** | 21 | 21 |
| **Type of Stroke** | **Ischemic** | 34 | 24 |
| | **Hemorrhagic** | 18 | 11 |
| | **Lacunar** | 6 | 2 |
| **Arteries involve** | **RMCA** | 12 | 8 |
| | **LMCA** | 36 | 1 |
| | **LMCA+ACA** | 3 | 20 |
| | **L. Choridal A** | 1 | 2 |
| | **BICA** | 1 | 1 |
| | **RICA** | 1 | 1 |
| | **PICA** | 1 | 1 |
| | **Small vessels** | 2 | 2 |
| | **LMCA+PICA** | 1 | 1 |

The study's findings shed light on the characteristics of patients who experienced ischemic strokes, revealing that 63.17% of the participants fell into this category. Notably, 37.3% of these cases showed involvement of the Left Middle Cerebral Artery (LMCA). A comprehensive analysis of anthropometric parameters unveiled significant differences (P value < 0.05) between the two groups. Specifically, individuals with ischemic strokes exhibited higher mean values of Waist-to-Hip Ratio (WHR) (cases = 1.014 ± 0.237) compared to the control group (0.922 ± 0.126). Furthermore, the cases had a lower mean weight (125.959 ± 49.610 lbs.) in contrast to the control group (165.782 ± 29.686 lbs.), and their waist circumference was also larger (100.334 ± 17.117) compared to the controls (90.936 ± 18.309).

**Table 2**

*Anthropometric parameter and lipid profile of stroke and control participants*

| Variables | Stroke 95<br>Mean± Std. D | Control 55<br>Mean± Std. D | P value |
|---|---|---|---|
| **Weight /Pound** | 125.959±49.610 | 164.782±29.686 | 0.000 |
| **Height/cm** | 163.726±14.737 | 162.186 ±14.705 | 0.538 |
| **BMI** | 28.128±16.022 | 27.649±5.718 | 0.574 |
| **Hip circumference /cm** | 100.897 ±16.022 | 98.741 ±14.394 | 0.411 |
| **waist circumference /cm** | 100.334 ±17.117 | 90.936 ±18.309 | 0.002 |
| **Waist Hip Ratio** | 1.014 ±.237 | 0.922±0.126 | 0.008 |
| **Hip waist Ratio** | 1.024±0.177 | 1.172±0.742 | 0.063 |
| **TG mg/dl** | 175.326±64.083 | 185.472±68.754 | 0.364 |
| **TC mg/dl** | 183.319±37.526 | 187.194±28.199 | 0.507 |
| **HDL mg/dl** | 38.608±9.200 | 41.818±11.182 | 0.059 |
| **LDL mg/dl** | 113.863±30.375 | 114.133±43.911 | 0.965 |
| **VLDL mg/dl** | 35.737±19.353 | 54.181±18.515 | 0.000 |

Biochemically, the control group displayed distinctive lipid profile characteristics. High-Density Lipoprotein (HDL) levels were notably higher in the control group (41.818 ± 11.182) compared to the cases (38.608 ± 9.200). Conversely, the mean value of Very Low-Density Lipoprotein (VLDL) exhibited a significant increase (P value < 0.05) in the control group (54.181 ± 18.515) compared to the cases (35.7379 ± 19.353). These outcomes underscore potential associations between these anthropometric and biochemical parameters and the occurrence and features of ischemic strokes, offering valuable insights into the multifaceted nature of this health condition.

## 3 DISCUSSION

This study was conducted on 150 participants in which 95 participants were with stroke and 55 participants were in control group. The mean ages of participants were 56.75 ±13.258. The mean age of stroke patients was 63.98 ± 10.65 and male gender was predominant. Previous studies showing similar tends with respect to age and gender [14]. Various studies conducted in Pakistan concluded the mean age of stroke patients was between 52 to 66 years, however female and male ratio was 1:5[15].

Results of this study revealed that the most common presentation was ischemic stroke followed by hemorrhagic stroke as shown in table 1 and this pattern is similar with the other researchers conducted on stroke. Research conducted Between 2002 and 2011 and published in 2018 showed that 81 % participants having ischemic stroke and remaining 19% have hemorrhagic stroke (16). Results of Study conducted in Agha khan hospital Karachi showed 596 patients were enrolled in 22 months in which 393 were with ischemic stroke and 126 were hemorrhagic stroke [17]. Regarding the involvement of artery left middle cerebral was the most commonly 56(37.2%) involved artery. Study conducted in Korean population showed that most involved artery was MCA at different positions [16]. Literature showed that underweight and overweight both having risk of stroke [18]. Systematic review indicated that how obesity and overweight increases the risk of sub type of strokes. Pasquale showed that hemorrhagic stroke is associated with obesity and overweight and ischemic stroke were more associated obesity than overweight regardless of age, gender, lifestyle, and cardiovascular risk factors [19]. Difference of Anthropometric parameters was found between cases and controls of present study. Mean values of Height, BMI, hip circumference, waist circumference and hip waist ratio were more in stroke patients than non-stroke patients. However, significant differences between two groups were found in mean values of weight, waist circumference and WHR as evident in table no. 2. Normal waist circumference is defined as less than 94 cm in men and less than 80 cm in women while waist more than 102 in men and 88 in women is related to high risk of diseases. Hip Waist ratio more than 0.8 in men and 0.95 in women is associated with CVD and stroke, (18). Another article published in LANCET described that HWR is better marker of stroke than BMI. This paper also quoted that HWR equal or more than 0.98 increased the risk of stroke 2.5 times more than normal HWR [20].

Multiple studies in Pakistan described that hyperlipidemia, sedentary habits, diet high in fats and carbohydrates are linked to the increased risk of stroke [21]. Role of Hyperlipidemia has already been established in the pathogeneses of cardiovascular and cerebral vascular diseases. On the other hand, some studies highlighted its negative role in the development of atherosclerotic plugs and others showing its protective role in healing of stroke [22]. To investigate it further present study also compares the lipid profile of cases and controls. Although there are several risk factors that are related to the

pathogenesis of stroke, but results of this study point out towards the importance of TG in the development of stroke as shown in table no. 2. According to the WHO and NCEP normal triglyceride level is less than 150 mg/dl [13]. Current study shows that both groups have elevated levels of TG,but stroke participants (185.4727) were revealing more mean values than non-stroke participants (175.3263), however Independent T test showed non-significant P value of stroke and non-stroke participants as shown in table no.2.

The mean values of total cholesterol (TC) in stroke participants (83.327mg/dl ± 42.994) and non-stroke participants (184.976 ± 37.374) were approximately equal as evident in table no. 2. Most of the studies described that the high cholesterol level causes increase risk of stroke and recent studies also favored that high level of cholesterol protects the reoccurrence of stroke [9]. Researchers also found that there is an inverse relation between the hemorrhagic stroke and total cholesterol, an increase 1mmole cholesterol decrease 15% risk of Hemorrhagic stroke [23]. HDL was higher in controls (44 ±14 )than in cases ( 39.134± 10.859 ) with P value of 0.059 as shown in table no.2 and hence , favoring the literature that shows the direct effects of increased level of HDL in the prevention of stroke and cardiovascular events (24).HDL not only showed protected effects on stroke but due to its documented action as a reverse transport of cholesterol, HDLs displays anti-oxidant, anti-inflammatory and anti-protease functions [25].

Findings of this study shown in table no. 2 with respect to LDL are contradict with previous studies. Mean scores of LDL in stroke and non-stroke participants were 113.863 ±30.375 and 114.133 ±43.911 respectively with P value of0.96. Study, published in 2016 described that there was a difference of LDL in stroke and non-stroke group. The LDL was higher in stroke patients and contributed to formation of atherosclerosis [24]. Significant difference was recorded in the mean values of VLDL between cases and controls with P value is less than 0.05 as evident in table no. 2. Research published in 2015 showed that patients died with stroke having VLDL level 38.52± 40.85 and patients discharge from hospital having VLDL level 26.09 ±21.49. [contradict in description introduction section about LDL & VLDL in stroke?] These results showed difference between these two groups [26].

## 4 CONCLUSION

Majority of the patients having ischemic stroke and involvement of left middle cerebral artery Significant differences were found in weight. waist circumference, waist-hip ratio and VLDL level and concluded that among anthropometric parameters WHR and waist circumference were predictors of stroke whereas weight, VLDL and HLD have a protective effect on the body from a stroke. Further large-scale studies including long time follow-up of participants is recommended to explore the outcome of stroke and control participants. Normal values of anthropometric and biochemical parameters are deficient in south Asia, especially in Pakistan and needed to explore.

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## INSTITUTIONAL REVIEW BOARD STATEMENT

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Research and Ethics Committee of The University of Lahore [Protocol number UOL-REC-481]

## DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to informed consent, assuring the participants that data will not be used for any other purpose other than presenting the findings in a summary form.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest

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**Author Contributions**

All authors contributed equally to the conception and design of the study, data collection, analysis, interpretation of results, and writing of the manuscript. All authors approved the final manuscript.

**Data availability**

All datasets relevant to this study's findings are fully available within the article.

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